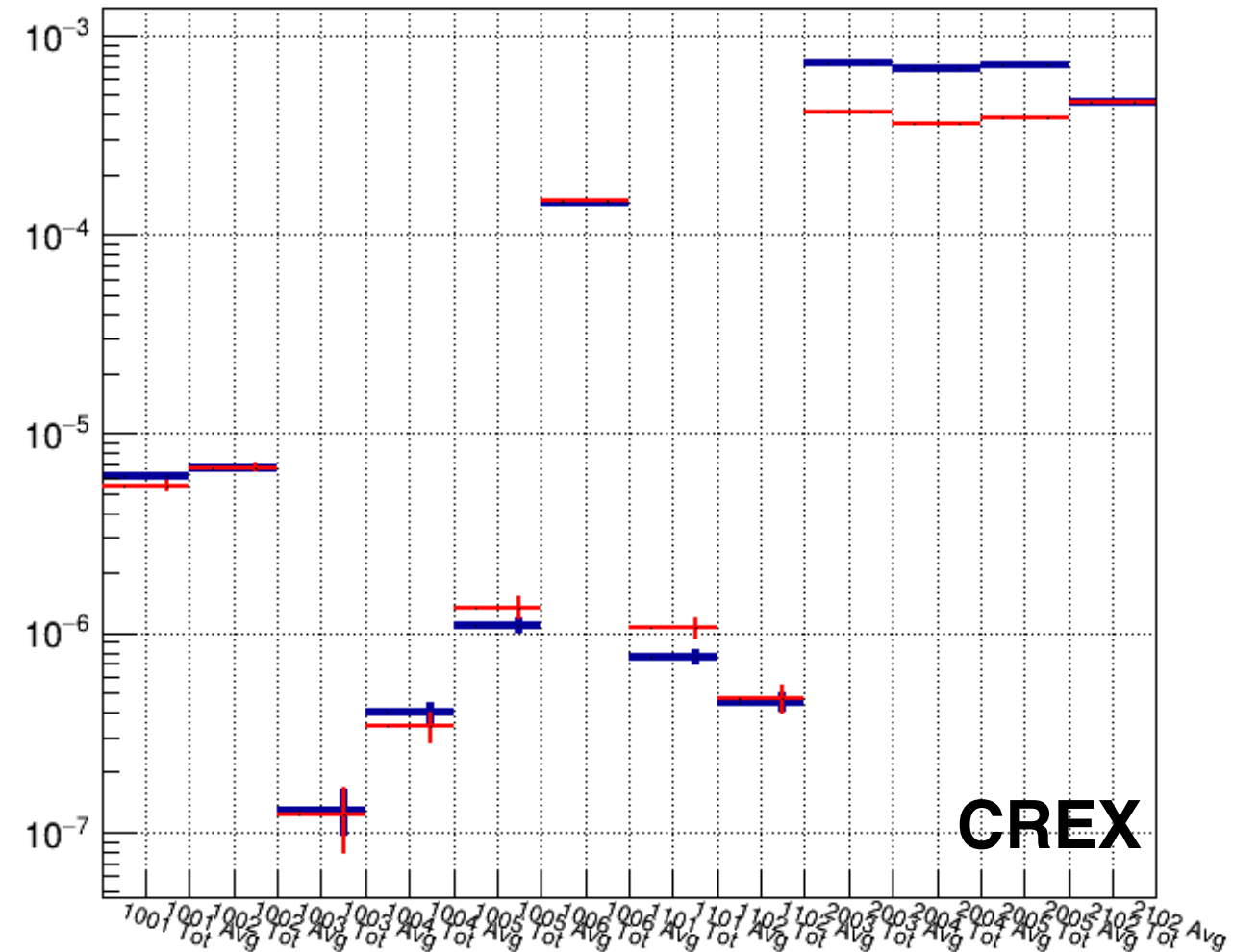
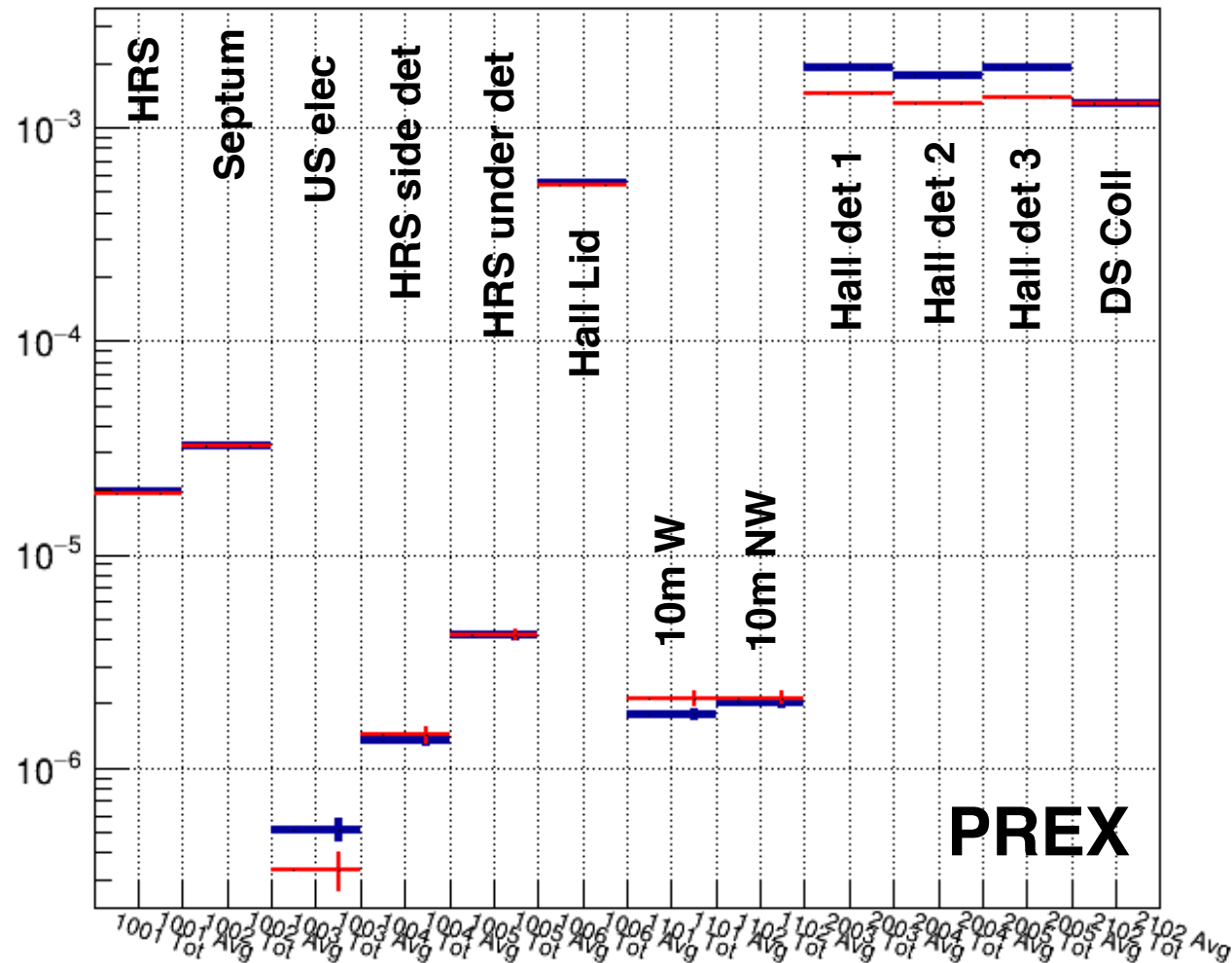


# PREX Dump configuration

Ciprian Gal  
UVa

# Vacuum in beampipe

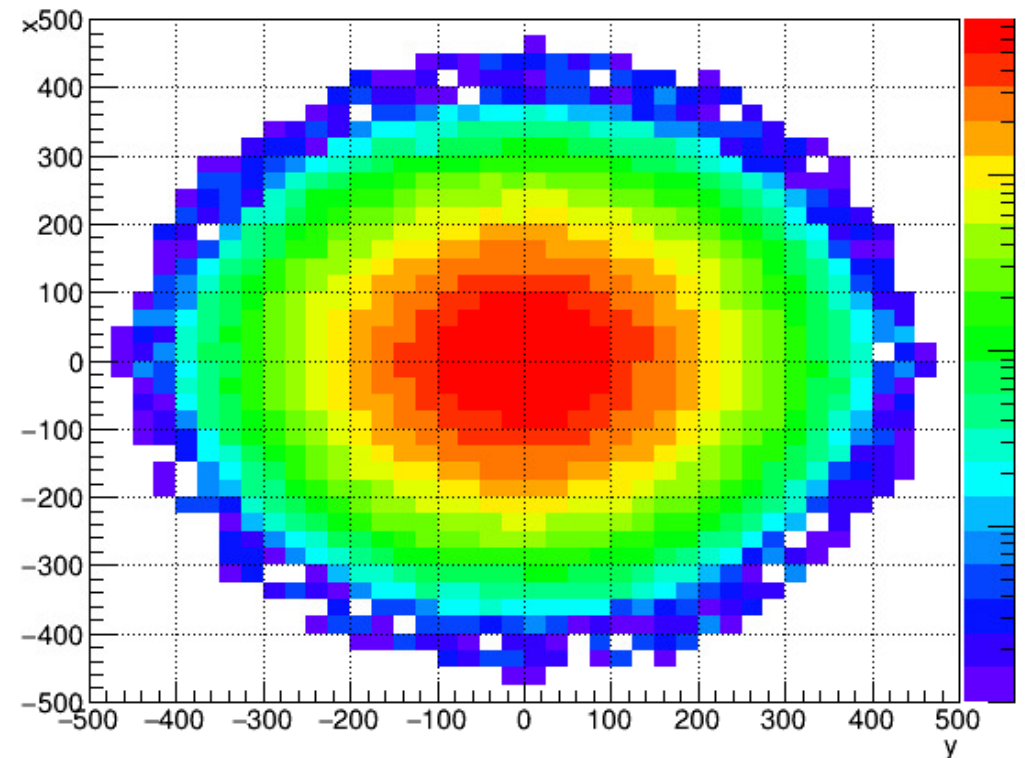


- Current in blue, comparison in red
- When implementing the beam pipe I included only the volumes containing materials
  - since the hall was filled with air otherwise, the hole inside the pipe was effectively air
- There are some small difference in the radiation at different points inside the hall, except for the Hall detectors



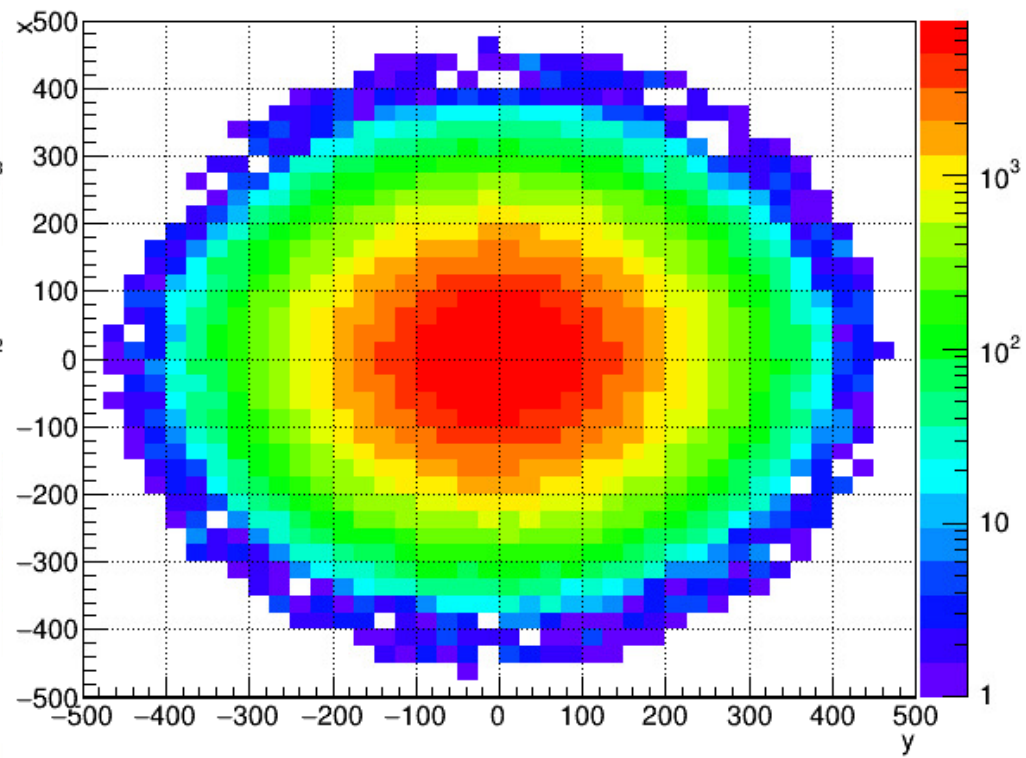
# Vacuum in beampipe

x:y {volume==2204 && PDGid==11}



**PREX Current**

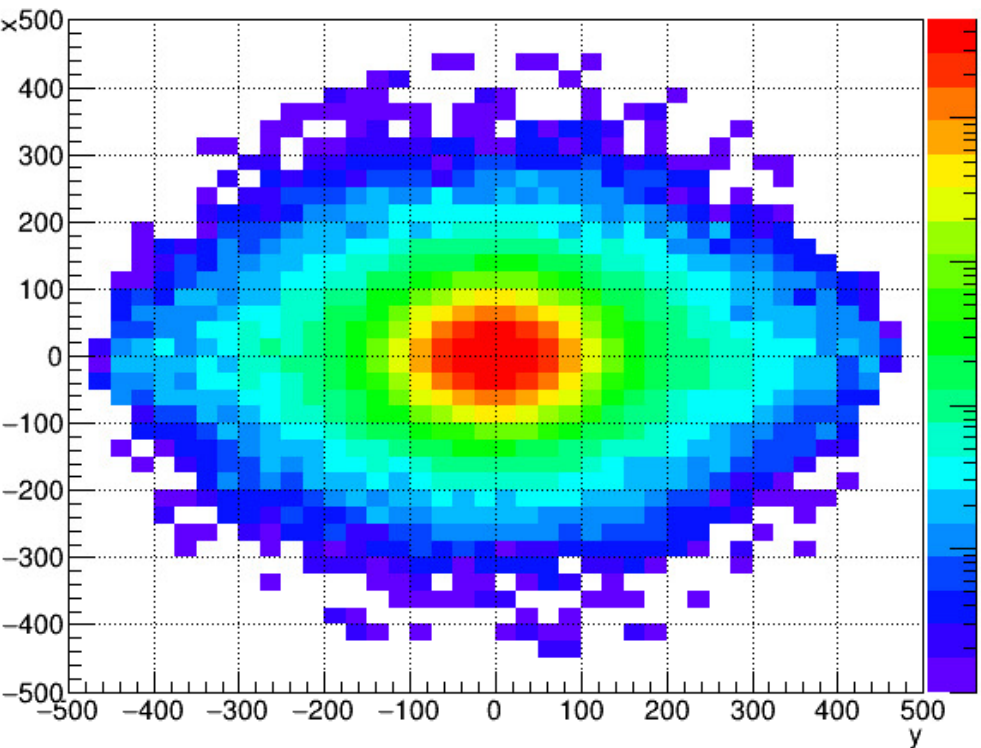
x:y {volume==2204 && PDGid==11}



**PREX Vacuum**

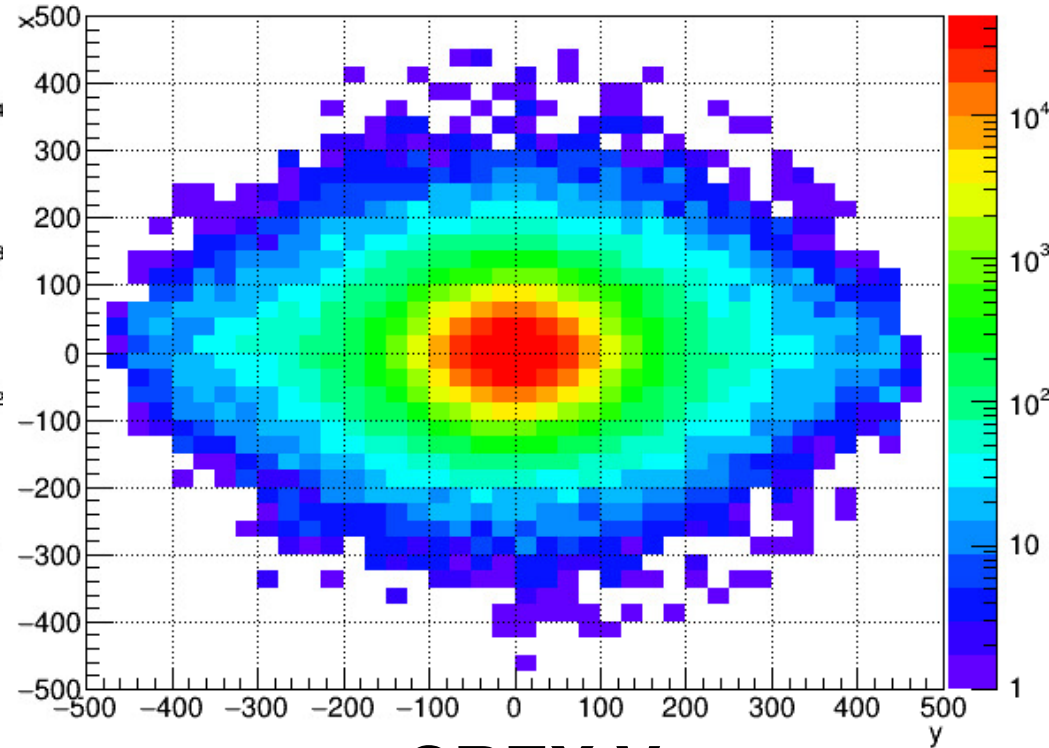
**Electrons @ 24m**

x:y {volume==2204 && PDGid==11}



**CREX Current**

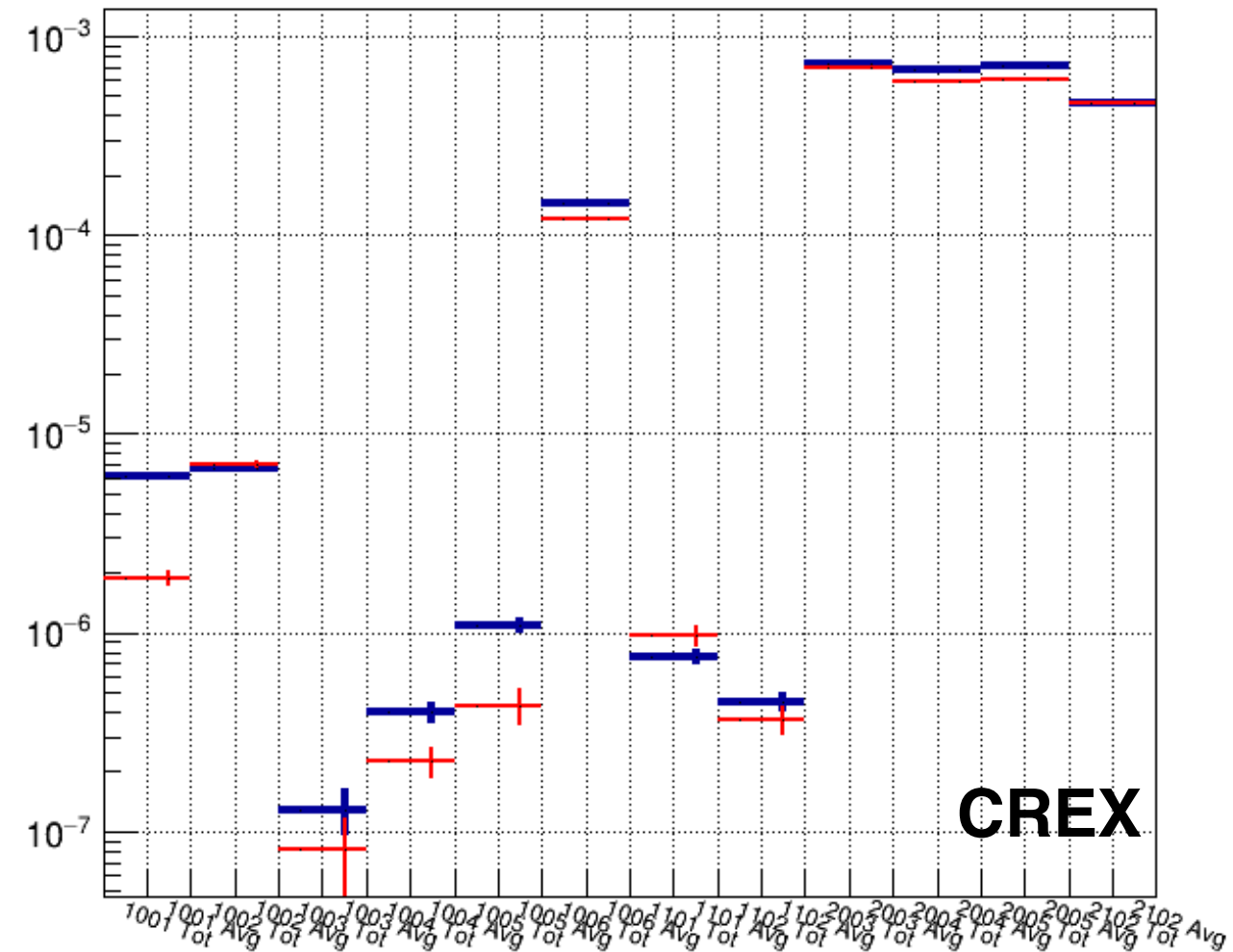
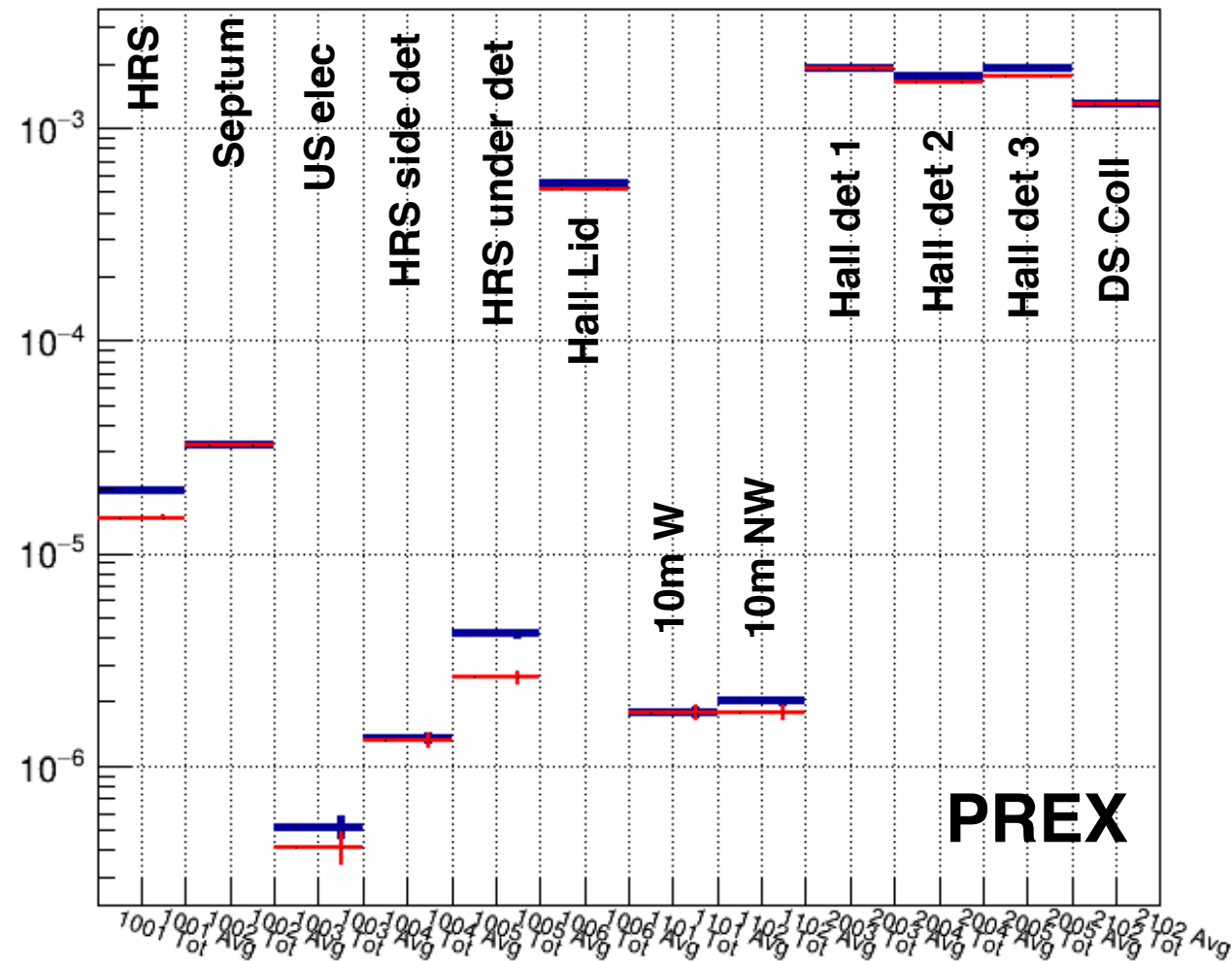
x:y {volume==2204 && PDGid==11}



**CREX Vacuum**

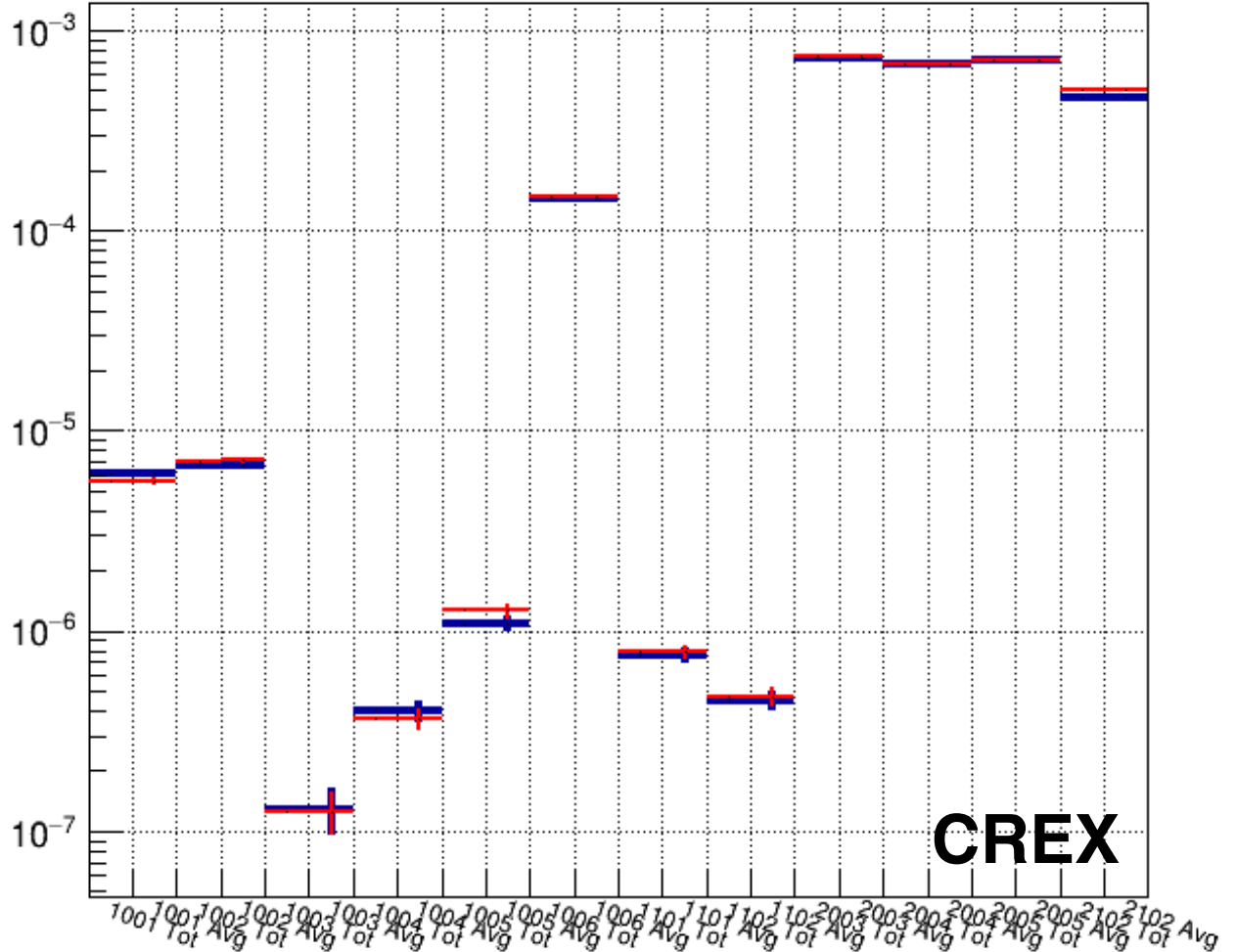
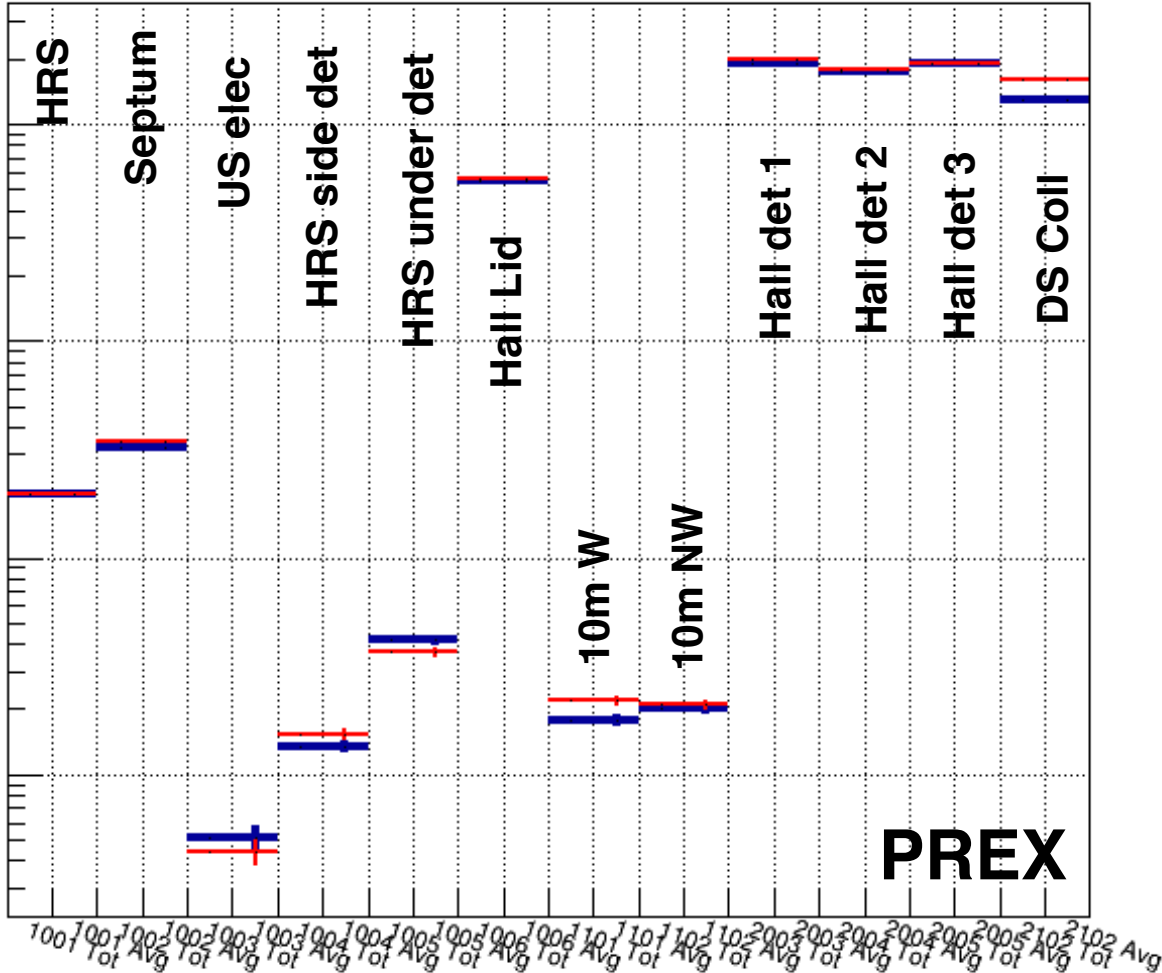
**Electrons @ 24m**

# No donut



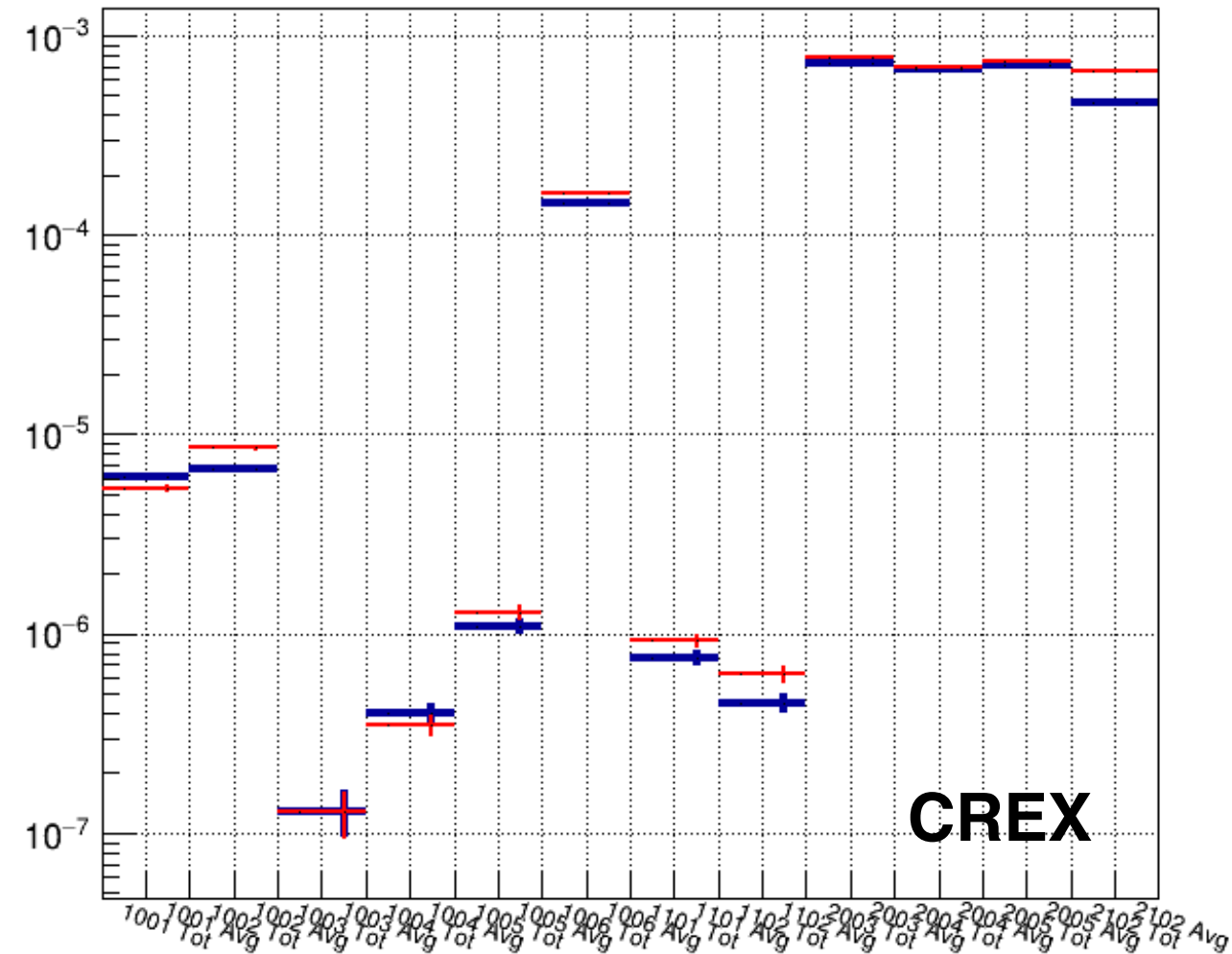
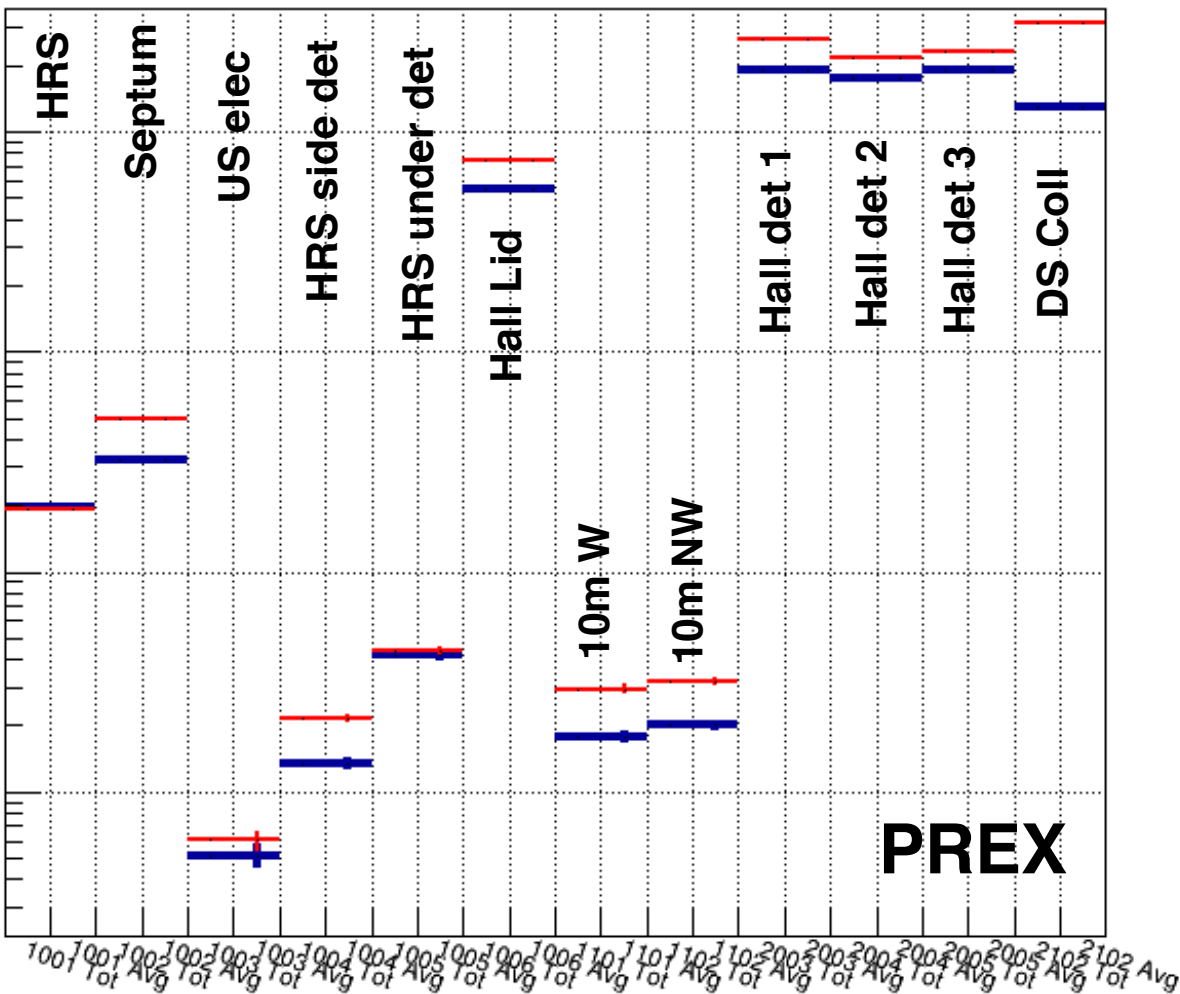
- Current in blue, comparison in red
- As expected this helps CREX quite a bit

# Tighter collimator 1



- Current in blue, comparison in red
- Tighter collimator to hide neck down (0.78 deg -> 0.59 deg; DS radius: 1.345->1.292)
- The radiation at the HRS platform does not really decrease (the decrease in radiation from the neck down is most likely compensated by more radiation inside the hall)
- Interesting that the hall lid does not see a significant increase

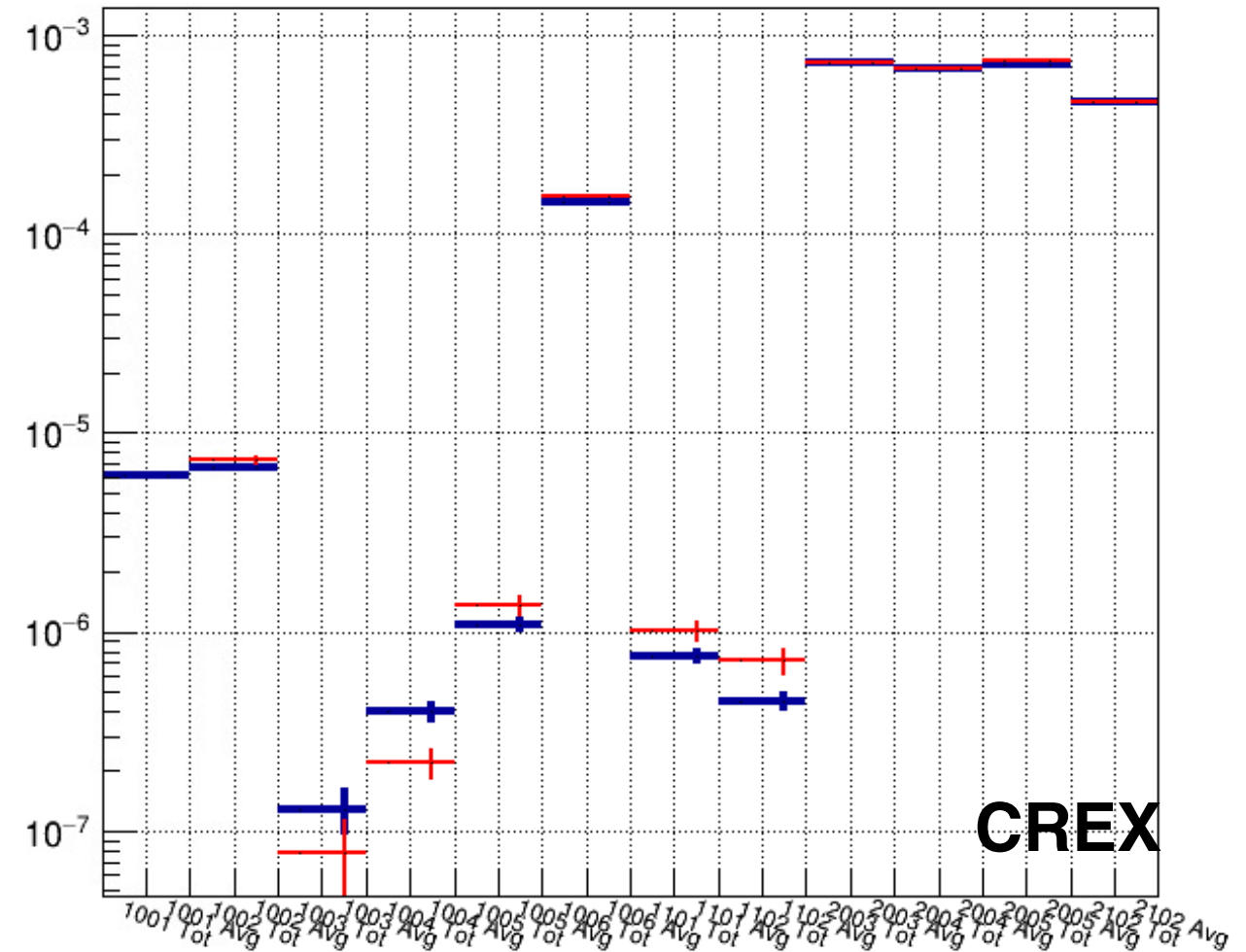
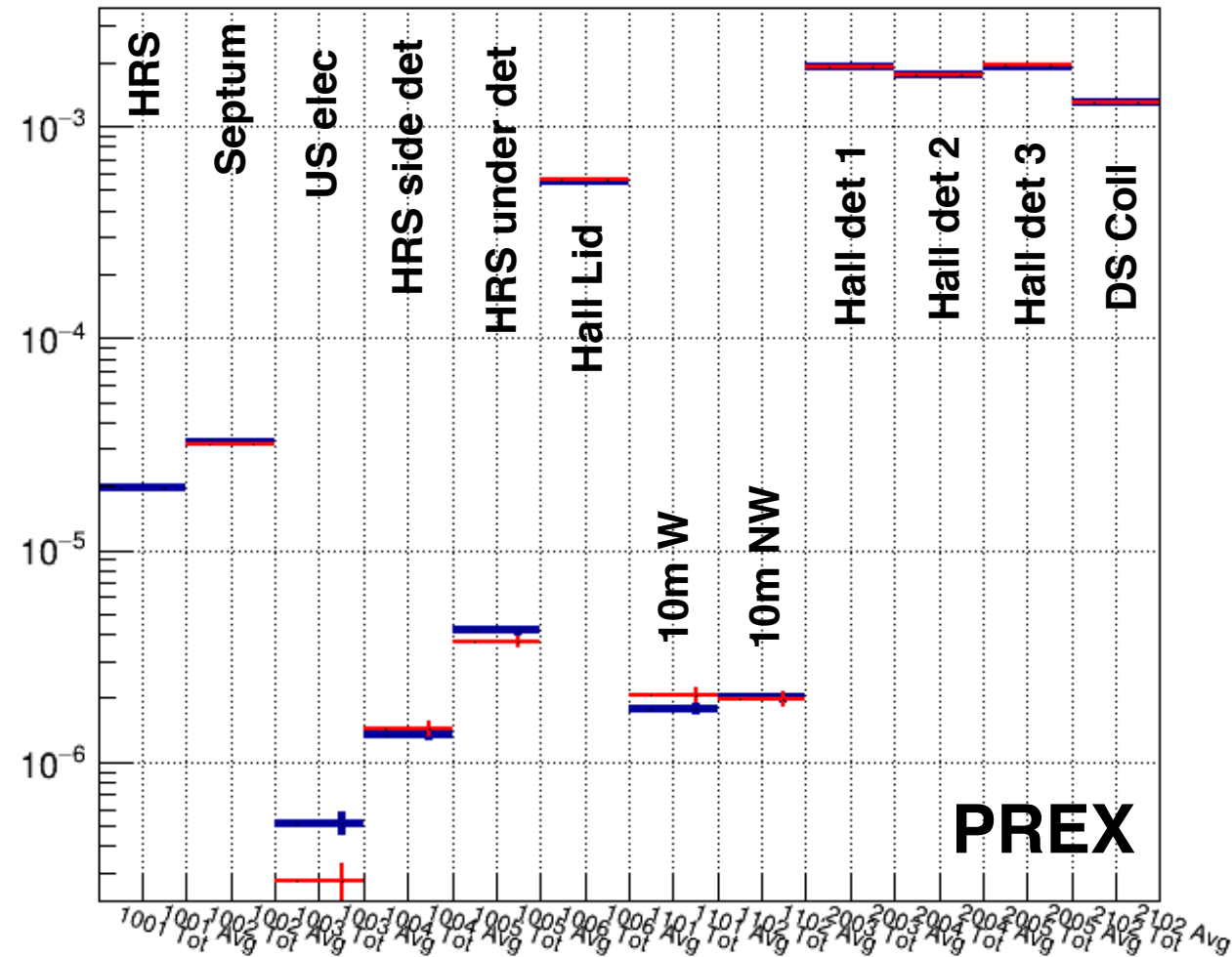
# Tighter collimator 2



- Current in blue, comparison in red
- Tighter collimator to hide half of donut; to  $R=15\text{cm}$  @ 2929 cm
  - (0.78 deg  $\rightarrow$  0.29 deg; DS radius: 1.345 $\rightarrow$ 1.212)
- Trying to hide part of the donut is not really a good option as the radiation field inside the hall is significantly increased

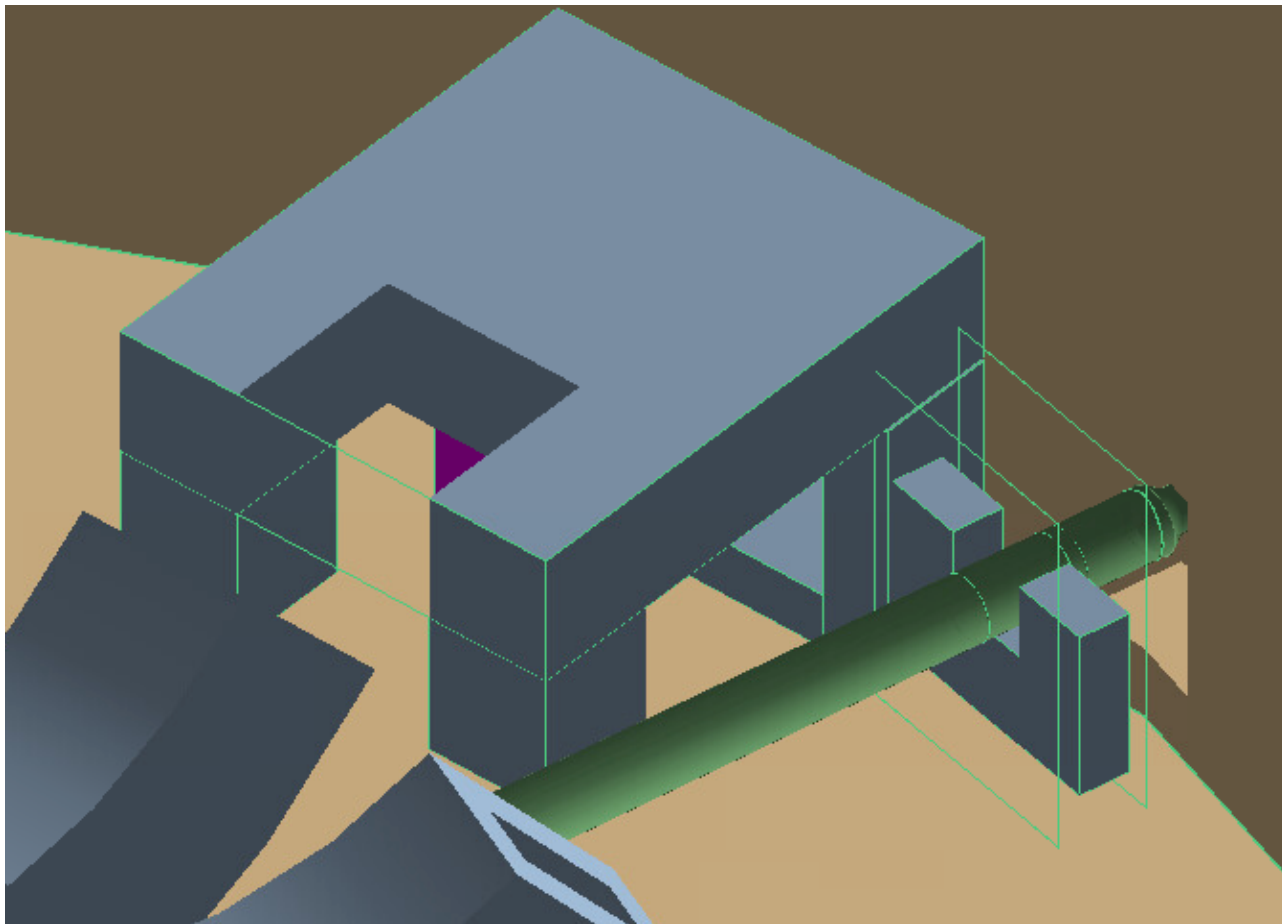
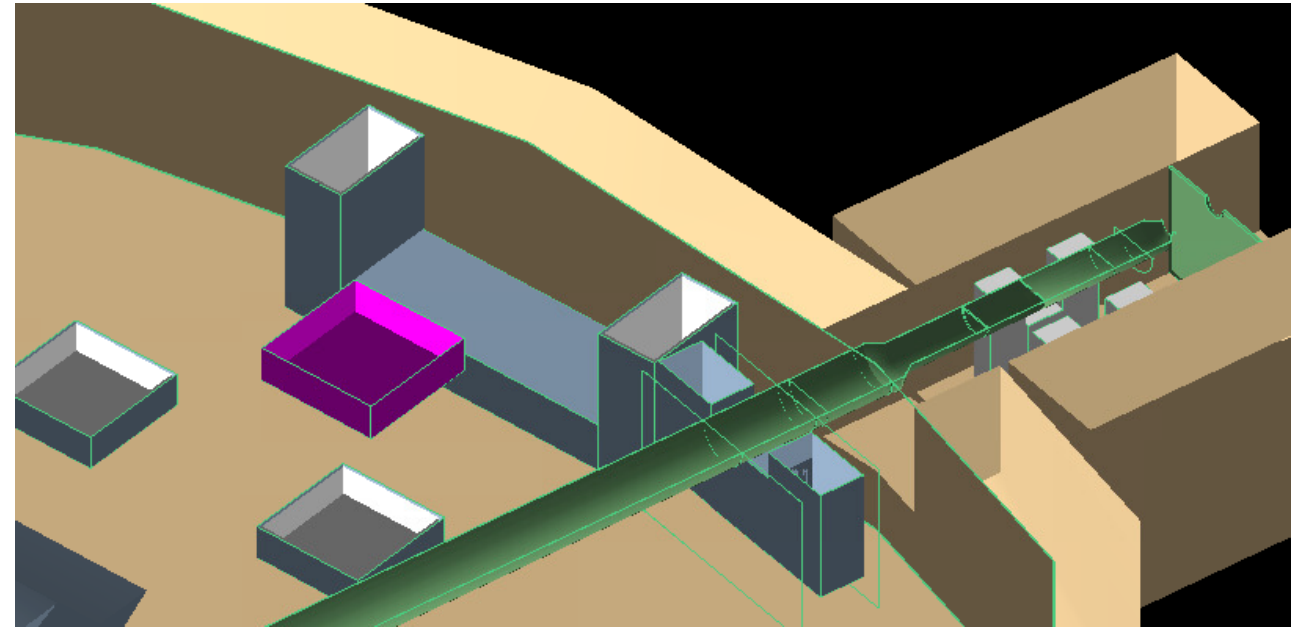
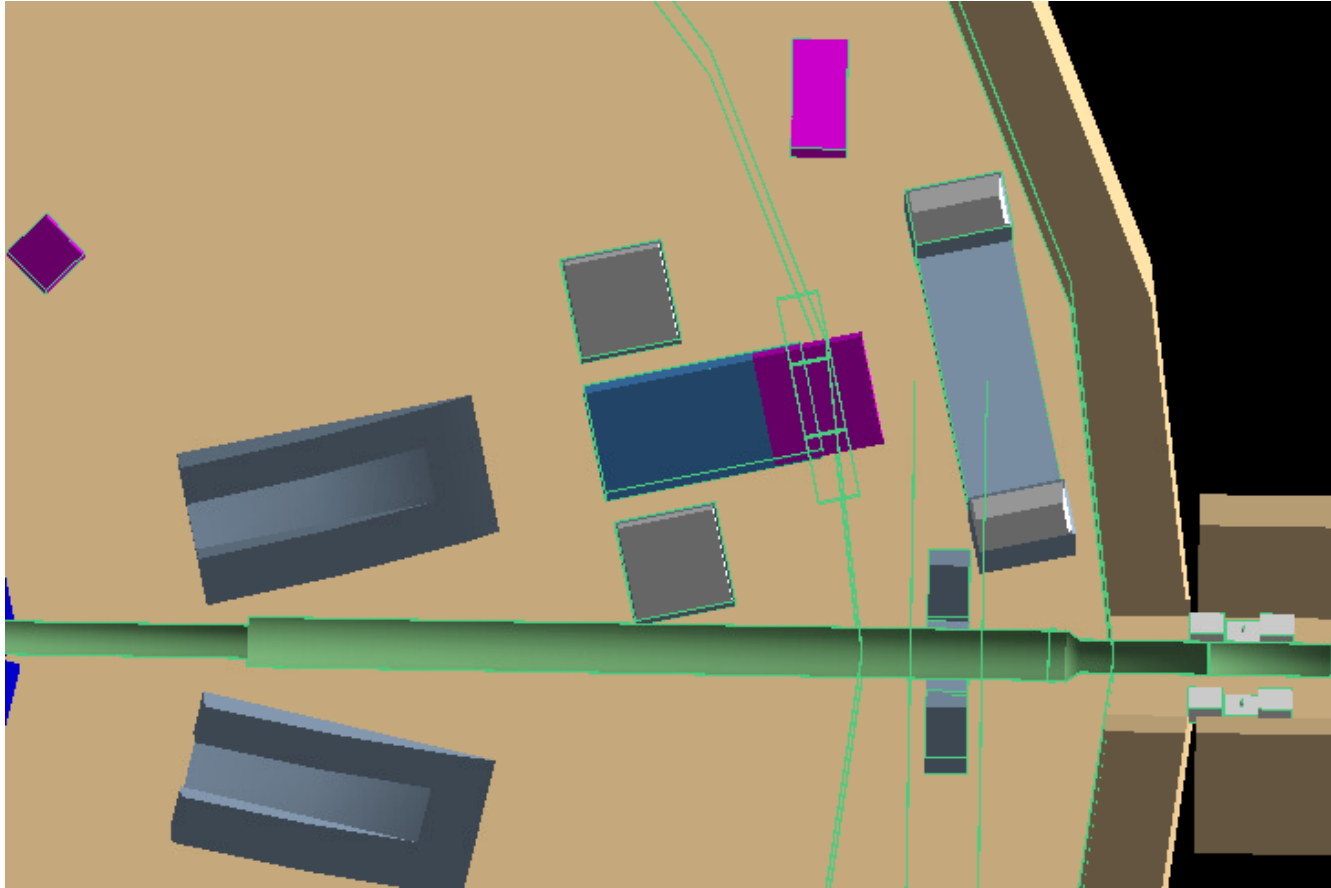


# Larger Hall



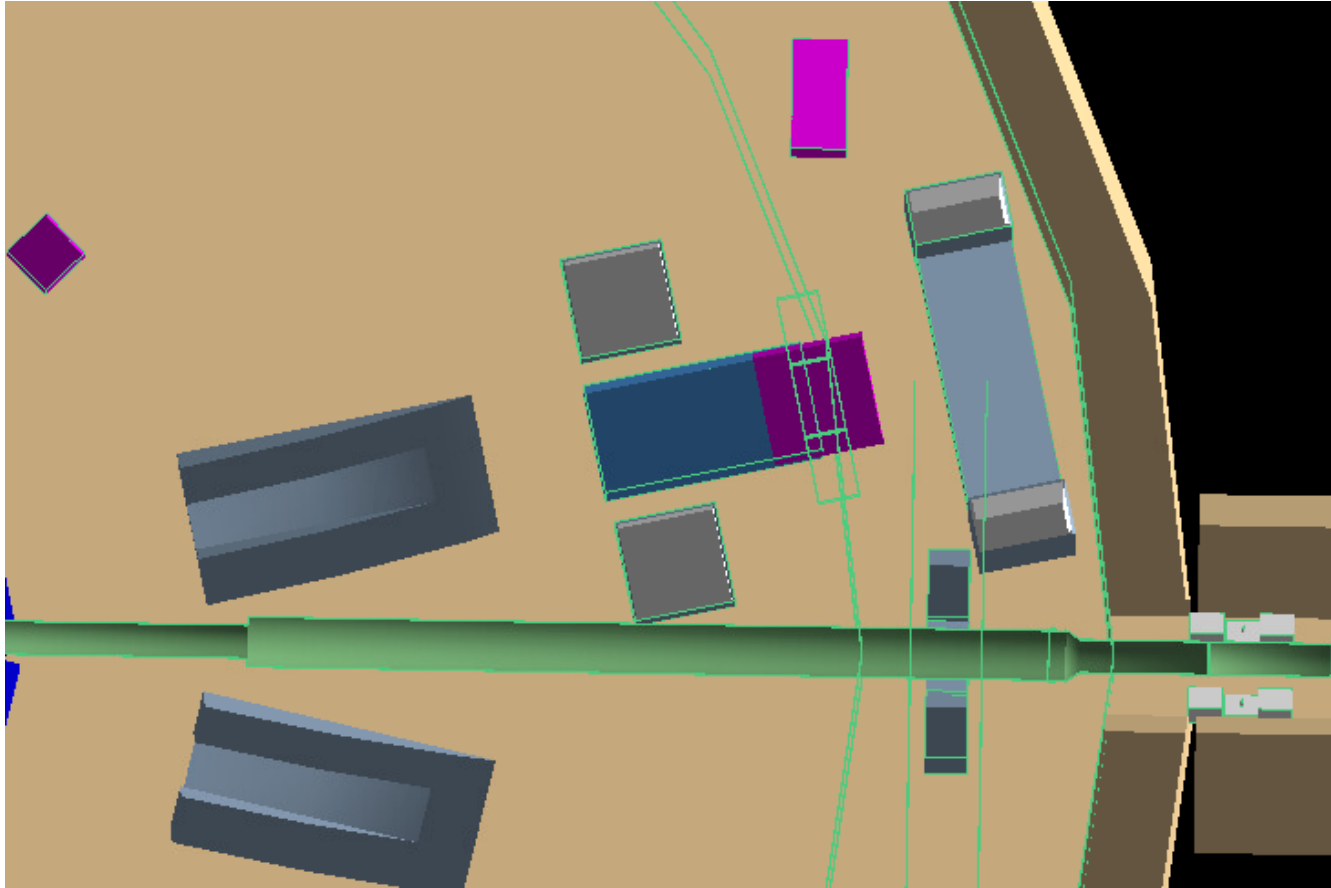
- Current in blue, comparison in red (unfortunately the HRS detector was not included in this simulation - > will have to rerun)
- While implementing the HRS platform from Maduka it became apparent that we were using the wrong radius for the hall (2546 cm). The radius Maduka had was 116 cm larger
  - This is consistent with my implementation of the length of the beam pipe sections
- Increasing the size of the hall, beam pipe has a small effect on the radiation damage seen (in particular for CREX)

# New HRS

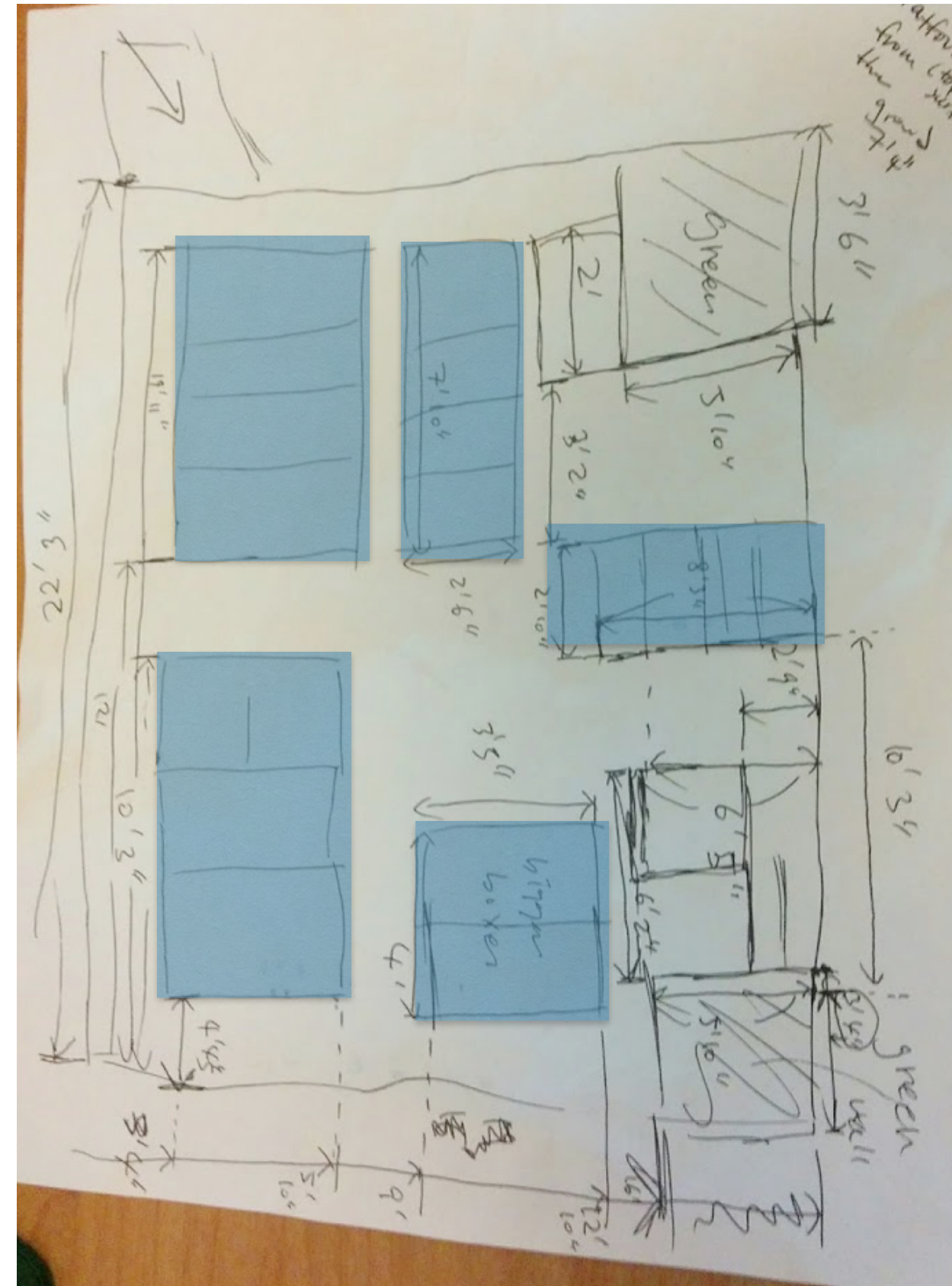


- The detector as implemented by Maduka (pink) sits right at the center of the HRS platform
  - it is significantly smaller than what we had (overlap in blue) and what is on the platform in reality
- plan to increase the size and extend it downstream and to size to make it more accurate
- The support structure is ~5cm thick iron with Air inside

# New HRS

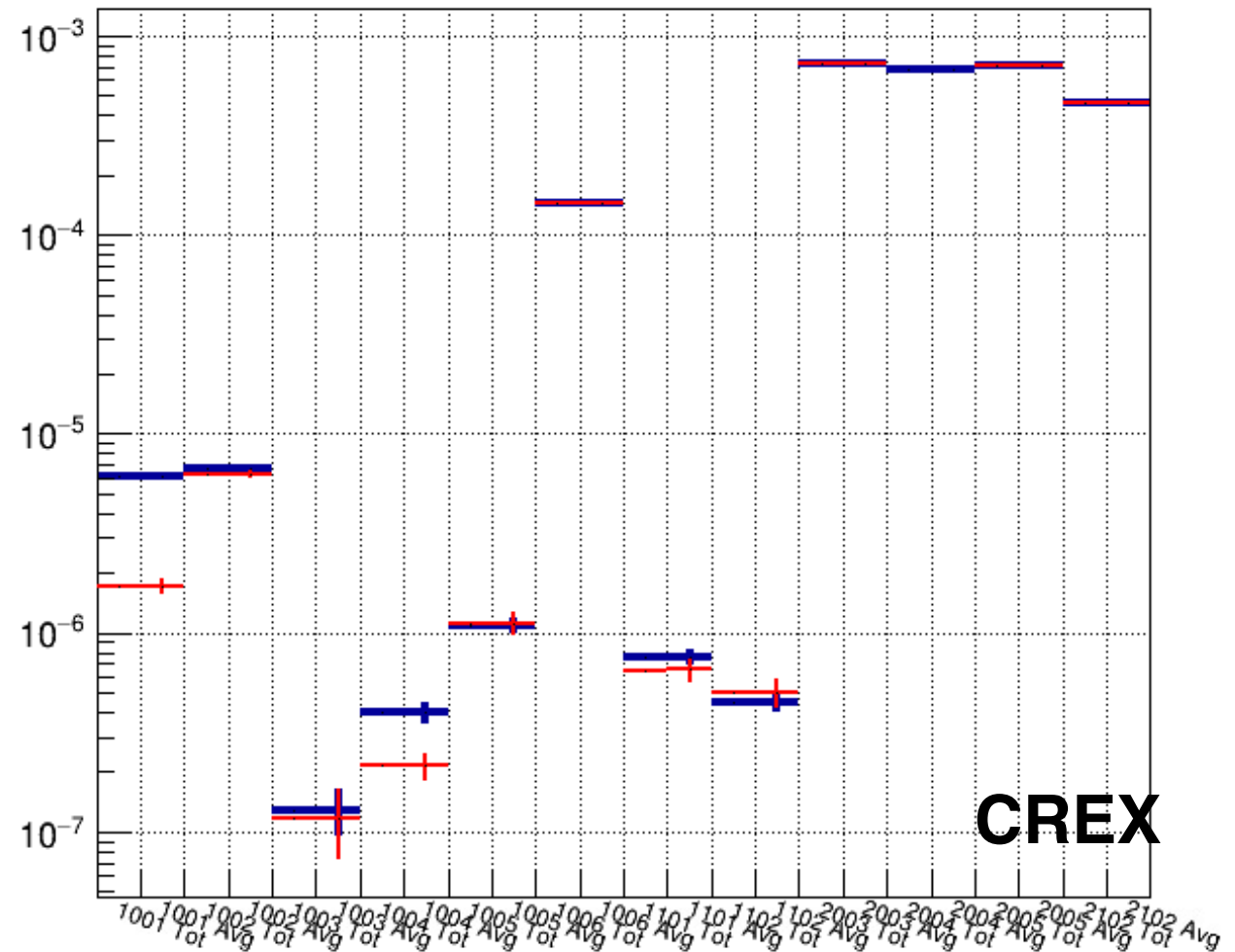
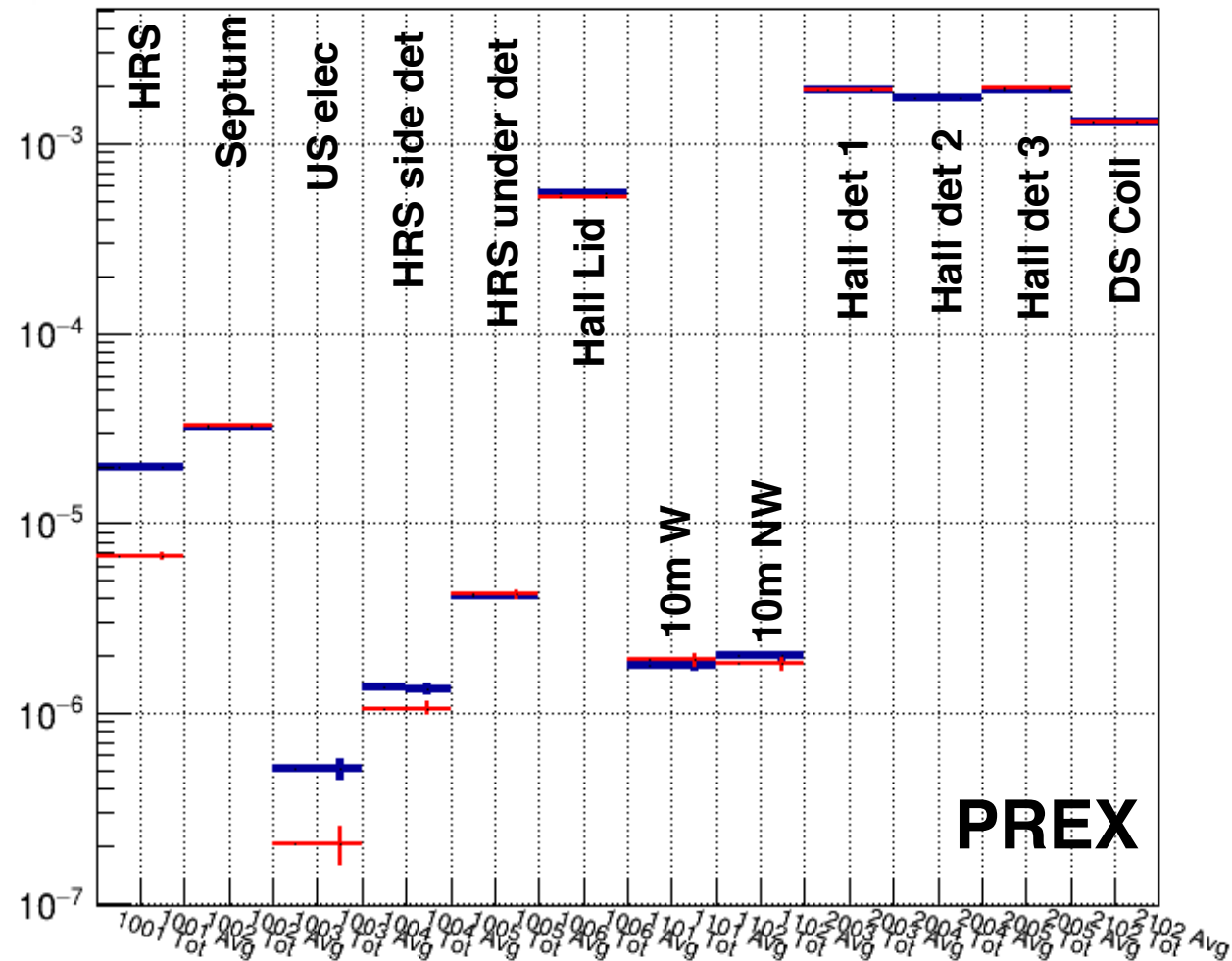


- Will need to look at some drawings for the HRS platform dimensions (not urgent)
- The dimensions that Maduka had for the pillars and the total size of the platform is consistent with what Sanghwa and I measured in the hall
- Electronics boxes are spread out over a larger area (highlighted regions on the right drawing) — drawing not to scale





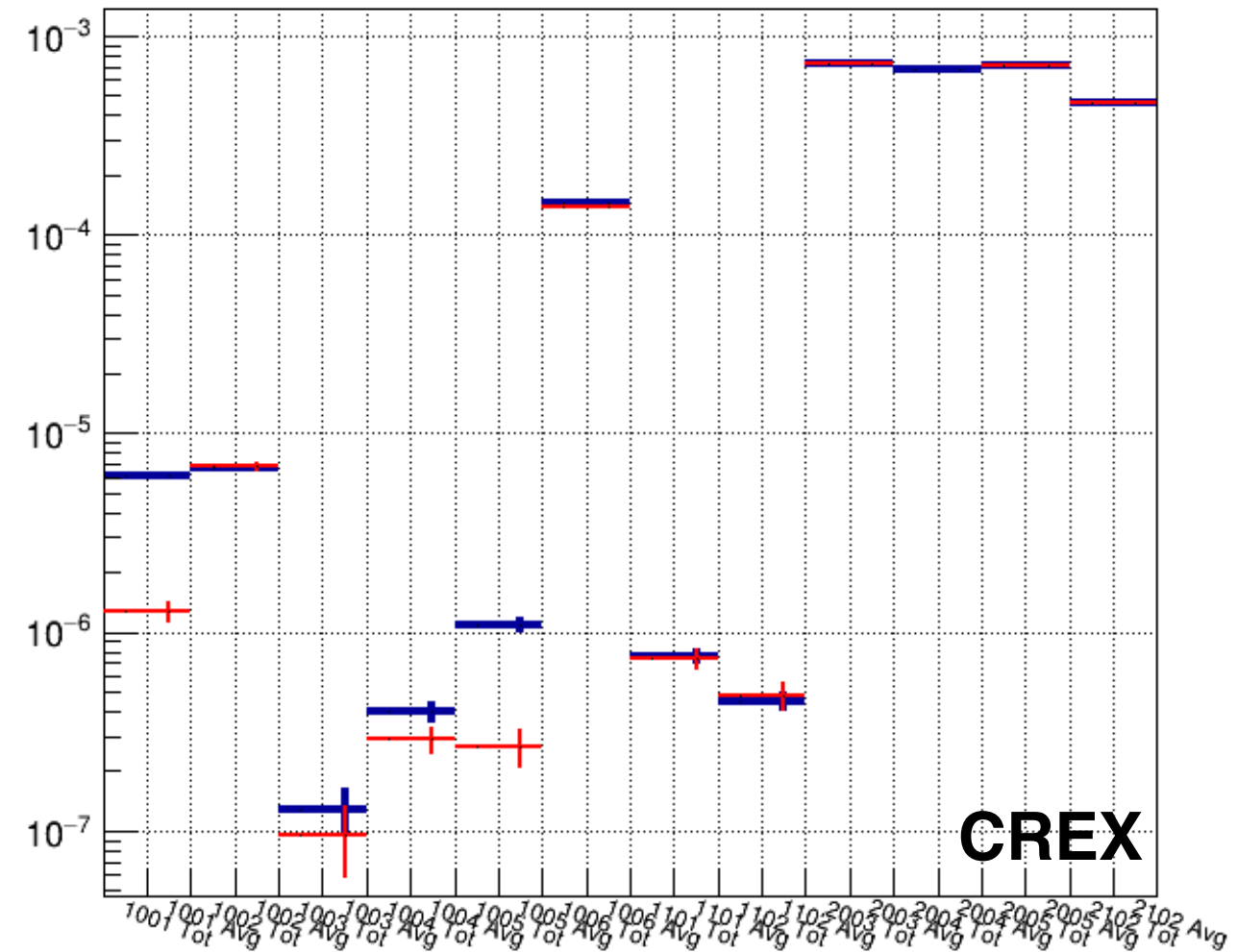
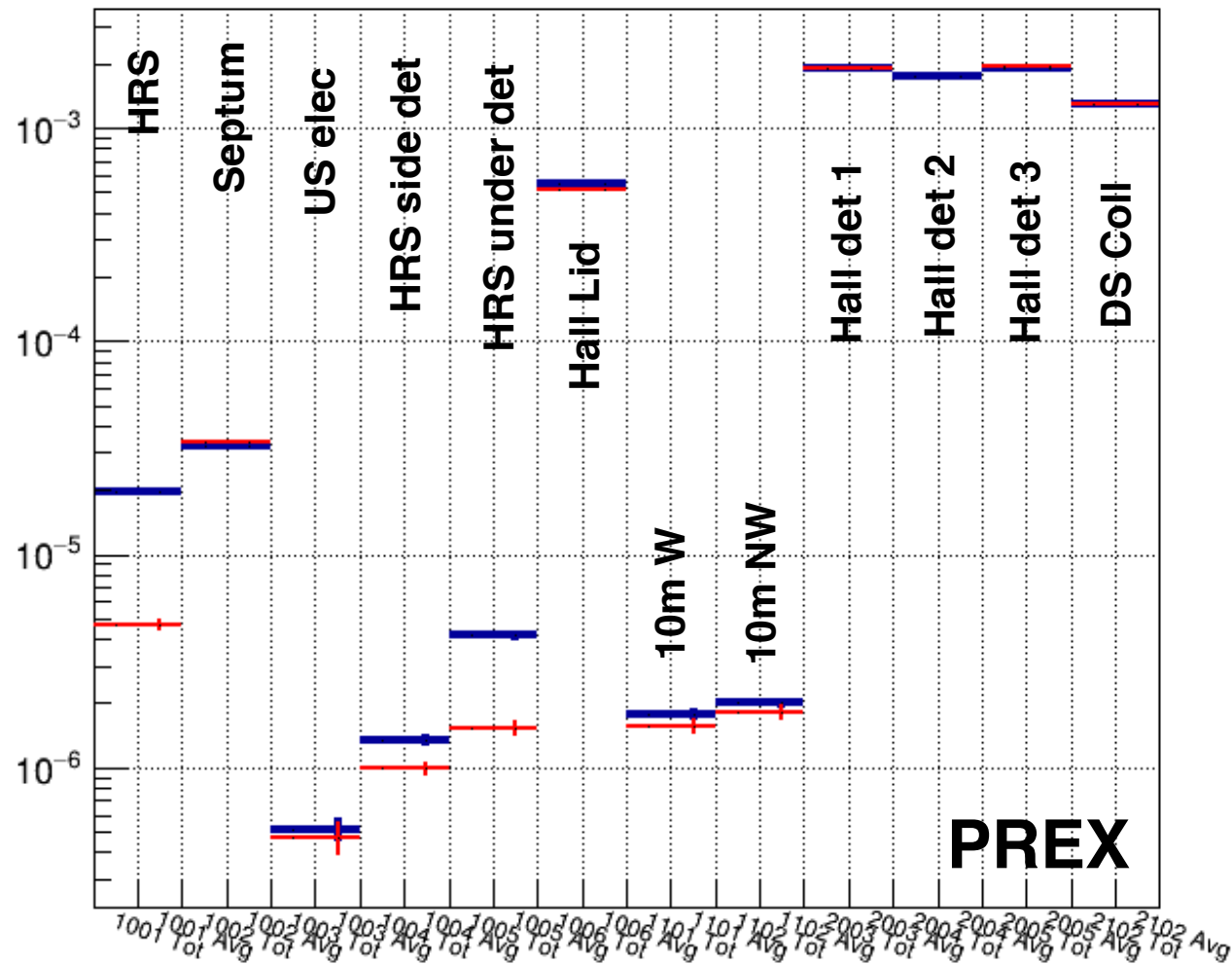
# New HRS



- Current in blue, comparison in red
  - had to remove the hall detector since it was overlapping with the HRS platform
- Because the HRS detector is now in the shadow of the platform legs it shows significantly smaller instantaneous levels of radiation
  - additionally this detector has ~60% of the surface area of the previous detector



# New HRS + 2ftIron



- Current in blue, comparison in red
- As before the 2ft of Iron helps with radiation seen at the platform

# Previous Summary table

	Total NEIL/cm2	uncert	Ratio to P1	uncert	Total NEIL/cm2	uncert	Ratio to P1	uncert
PREX1 (ERR dump)	4.60E+10	1.79E+09	1.00	0.06	7.43E+10	4.92E+09	1.00	0.09
PREX1 (actual dump)	4.05E+10	1.68E+09	0.88	0.05	7.78E+10	5.39E+09	1.05	0.10
PREX2 ERR	4.96E+09	6.72E+08	0.11	0.02	1.09E+10	2.61E+09	0.15	0.04
PREX2 current	5.77E+10	5.69E+09	1.25	0.13	7.60E+10	1.85E+10	1.02	0.26
P2 with P1pipe	2.12E+10	3.38E+09	0.46	0.08	4.39E+10	1.31E+10	0.59	0.18
P2 current+4in	4.46E+10	4.64E+09	0.97	0.11	6.68E+10	1.45E+10	0.90	0.20
P2 current+Conc	2.38E+10	3.44E+09	0.52	0.08	2.76E+10	1.04E+10	0.37	0.14
P2 current+ (Conc*2)	1.54E+10	1.81E+09	0.33	0.04	1.72E+10	4.07E+09	0.23	0.06
P2 current+ (Conc*0.5)	2.70E+10	2.63E+09	0.59	0.06	2.40E+10	6.13E+09	0.32	0.09
P2 current+Poly	2.19E+10	3.09E+09	0.48	0.07	5.40E+10	1.59E+10	0.73	0.22
P2 current+4in+1ftCont	1.83E+10	2.84E+09	0.40	0.06	2.69E+10	7.95E+09	0.36	0.11
P2 current + donut shield	5.27E+10	5.61E+09	1.15	0.13	8.28E+10	1.98E+10	1.11	0.28
P2+2Pipe+2ftIron	2.30E+10	3.01E+09	0.50	0.07	1.51E+10	6.31E+09	0.20	0.09
P2+2Pipe+2ftIron+Wdonut	2.38E+10	3.10E+09	0.52	0.07	1.68E+10	5.59E+09	0.23	0.08
CREX ERR	6.73E+09	2.05E+09	0.15	0.04	1.31E+10	6.57E+09	0.18	0.09
C5 current	3.86E+10	7.80E+09	0.84	0.17	4.70E+10	1.96E+10	0.63	0.27
C5 current+4in	9.86E+09	2.61E+09	0.21	0.06	3.80E+10	2.11E+10	0.51	0.29
C5 P1pipe	7.31E+10	1.12E+10	1.59	0.25	1.06E+11	3.38E+10	1.43	0.47
C5 current+Conc	2.23E+10	5.78E+09	0.49	0.13	3.21E+10	1.65E+10	0.43	0.22
C5 current+(Conc*2)	1.73E+10	3.23E+09	0.38	0.07	2.68E+10	1.00E+10	0.36	0.14
C5 current+(Conc*0.5)	1.70E+10	3.35E+09	0.37	0.07	1.09E+10	5.20E+09	0.15	0.07
C5 current+Poly	1.86E+10	5.13E+09	0.40	0.11	1.40E+10	1.01E+10	0.19	0.14
C5 current+ 2Pipe septum	3.85E+10	8.70E+09	0.84	0.19	9.65E+10	3.52E+10	1.30	0.48
C5 current+ 4in+1ftConc	1.01E+10	3.28E+09	0.22	0.07	3.85E+10	2.35E+10	0.52	0.32
C5 current+2Pipe+donut shield	4.09E+10	7.86E+09	0.89	0.17	4.73E+10	2.41E+10	0.64	0.33
C5+2Pipe+2ftIron	1.78E+10	5.20E+09	0.39	0.11	1.00E+10	5.61E+09	0.13	0.08
C5+2Pipe+2ftIron+Wdonut	2.35E+10	6.03E+09	0.51	0.13	2.21E+10	1.30E+10	0.30	0.18

# New Summary table

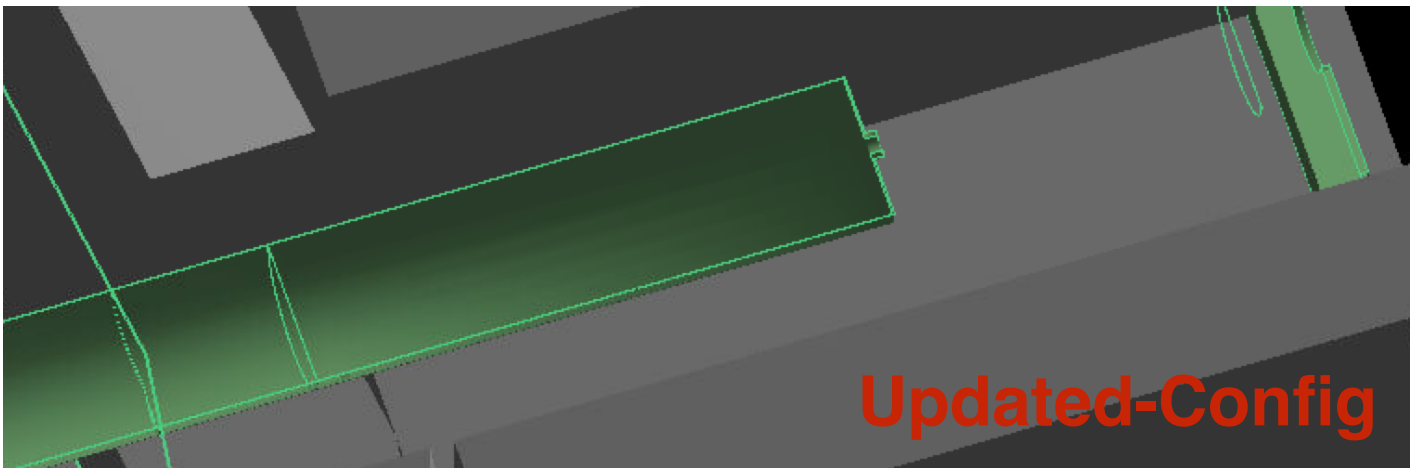
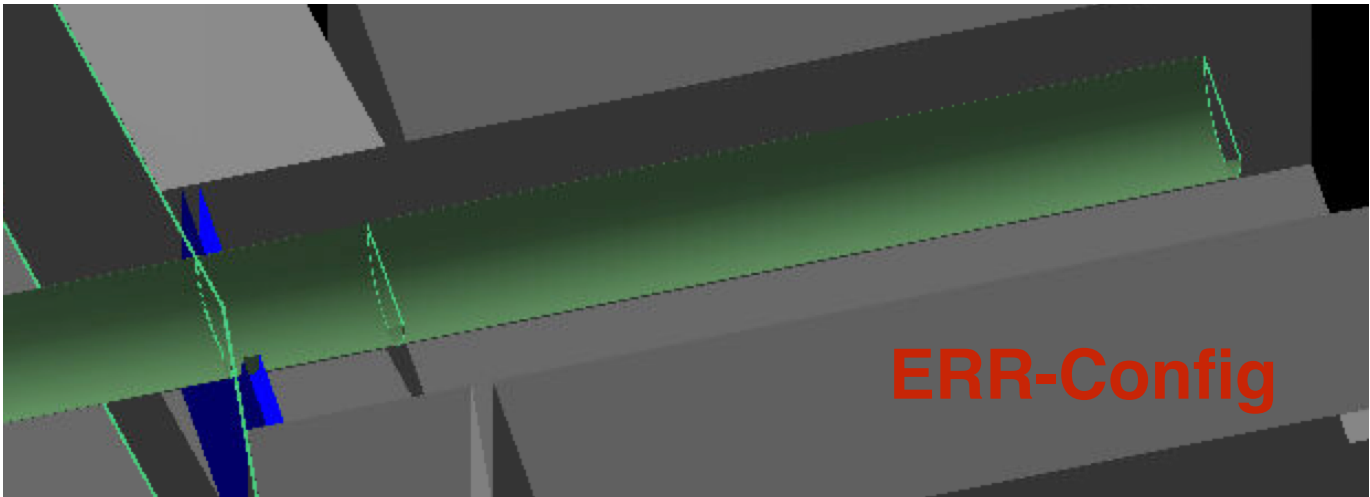
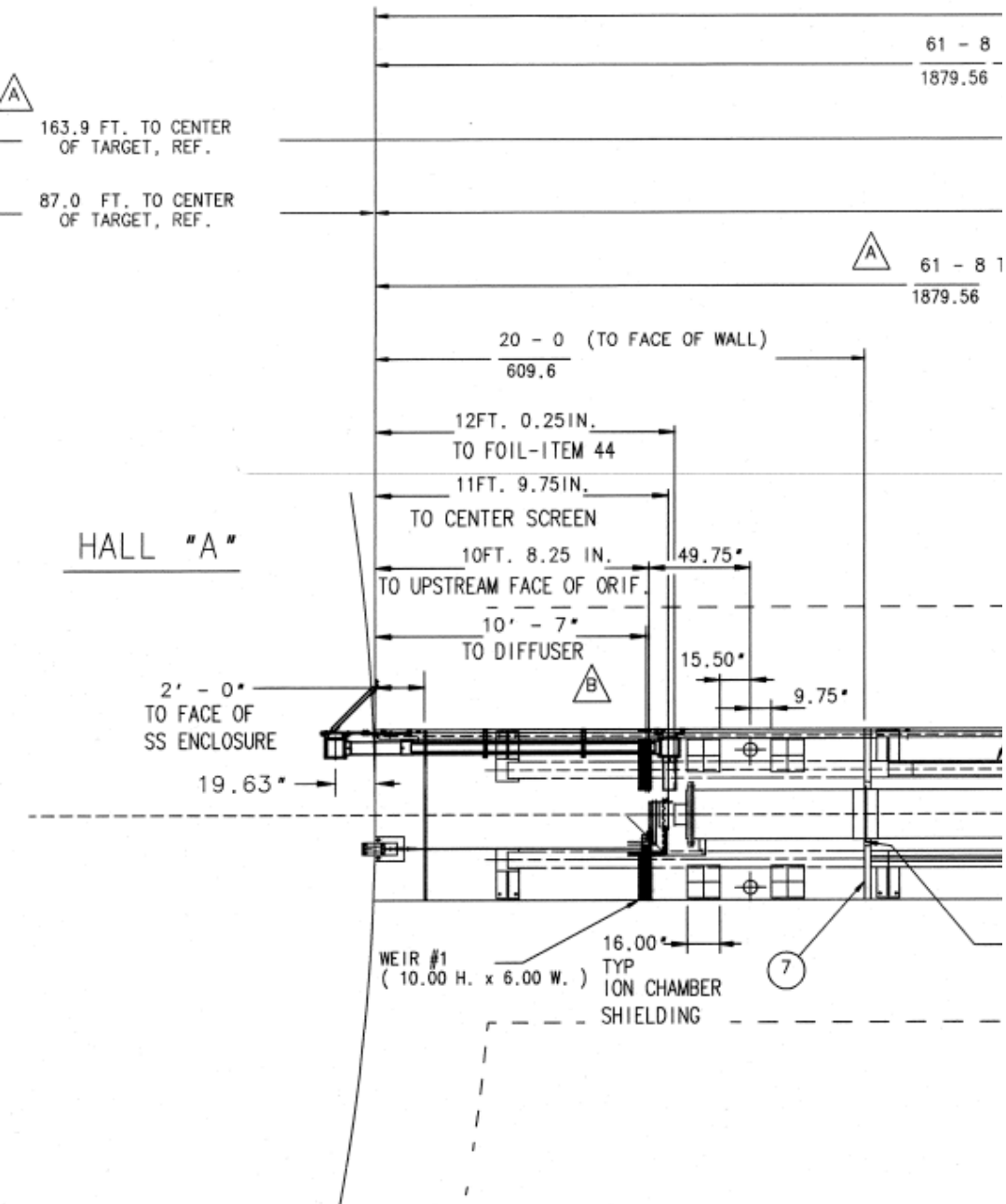
		HRS detector				Under detector			
		Total NEIL/cm2	uncert	Ratio to P1	uncert	Total NEIL/cm2	uncert	Ratio to P1	uncert
	PREX1 (ERR dump)	4.60E+10	1.79E+09	1.00	0.06	7.43E+10	4.92E+09	1.00	0.09
	PREX2 current	5.77E+10	5.69E+09	1.25	0.13	7.60E+10	1.85E+10	1.02	0.26
	C5 current	3.86E+10	7.80E+09	0.84	0.17	4.70E+10	1.96E+10	0.63	0.27
PREX 2	current (farm)	5.23E+10	1.11E+09	1.14	0.05	8.03E+10	3.77E+09	1.08	0.09
	vacuum beamline	5.12E+10	1.55E+09	1.11	0.05	8.06E+10	5.34E+09	1.09	0.10
	no donut	3.90E+10	1.31E+09	0.85	0.04	5.04E+10	3.74E+09	0.68	0.07
	smaller Coll Neck	5.24E+10	1.13E+09	1.14	0.05	7.05E+10	3.38E+09	0.95	0.08
	smaller Coll MidDonut	5.16E+10	1.08E+09	1.12	0.05	8.39E+10	3.63E+09	1.13	0.09
	larger Hall	N/A	N/A	N/A	N/A	7.08E+10	4.62E+09	0.95	0.09
	new HRS	3.00E+10	1.45E+09	0.65	0.04	8.12E+10	5.42E+09	1.09	0.10
	New HRS + 2ft Iron	2.07E+10	1.17E+09	0.45	0.03	2.97E+10	2.81E+09	0.40	0.05
CREX 5	current (farm)	4.47E+10	1.84E+09	0.97	0.06	5.78E+10	5.41E+09	0.78	0.09
	vacuum beamline	4.01E+10	2.50E+09	0.87	0.06	7.14E+10	8.97E+09	0.96	0.14
	no donut	1.37E+10	1.20E+09	0.30	0.03	2.29E+10	4.73E+09	0.31	0.07
	smaller Coll Neck	4.10E+10	1.73E+09	0.89	0.05	6.70E+10	6.01E+09	0.90	0.10
	smaller Coll MidDonut	3.89E+10	1.70E+09	0.85	0.05	6.77E+10	6.03E+09	0.91	0.10
	larger Hall	N/A	N/A	N/A	N/A	7.29E+10	9.23E+09	0.98	0.14
	new HRS	2.09E+10	2.04E+09	0.45	0.05	5.92E+10	7.85E+09	0.80	0.12
	New HRS + 2ft Iron	1.54E+10	1.76E+09	0.34	0.04	1.42E+10	3.21E+09	0.19	0.05

# Next steps

- Clean up codebase to allow others to work on this
- Rerun the larger hall simulation with the HRS detector included
  - Fix detector positions around donut
- Increase the area of the HRS electronics detector
- Look at combinations of materials for the shielding

# PREX 1 radiation estimation

Hall A dump configuration from Keith W. for 2010:



- PREX 1 estimates were done with a rudimentary dump configuration (most of the radiation to electronics came from within the hall proper)
  - The splash back from the dump was simulated by putting a stainless steel wall at the entrance of the dump tunnel
- The updated configuration with 4in aperture and the Al wall produced similar levels of radiation to the HRS platform

	ERR	Update
HRS rad [NEIL/cm2]	2.3E+11	2.1E+11

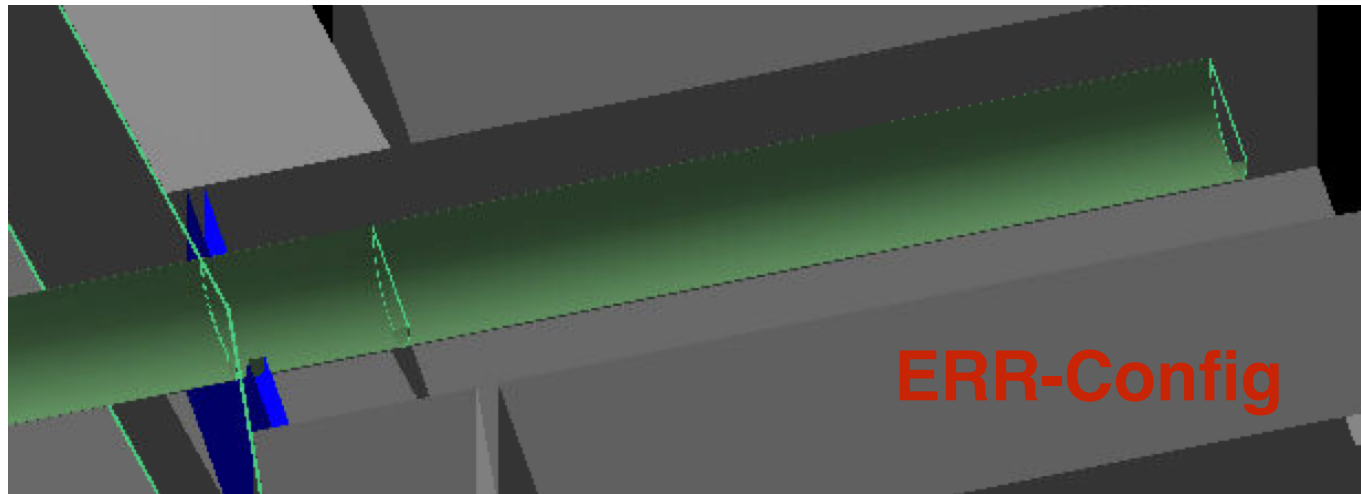


# ERR estimates

1MeV  $n_{eq}$  /  $cm^2$

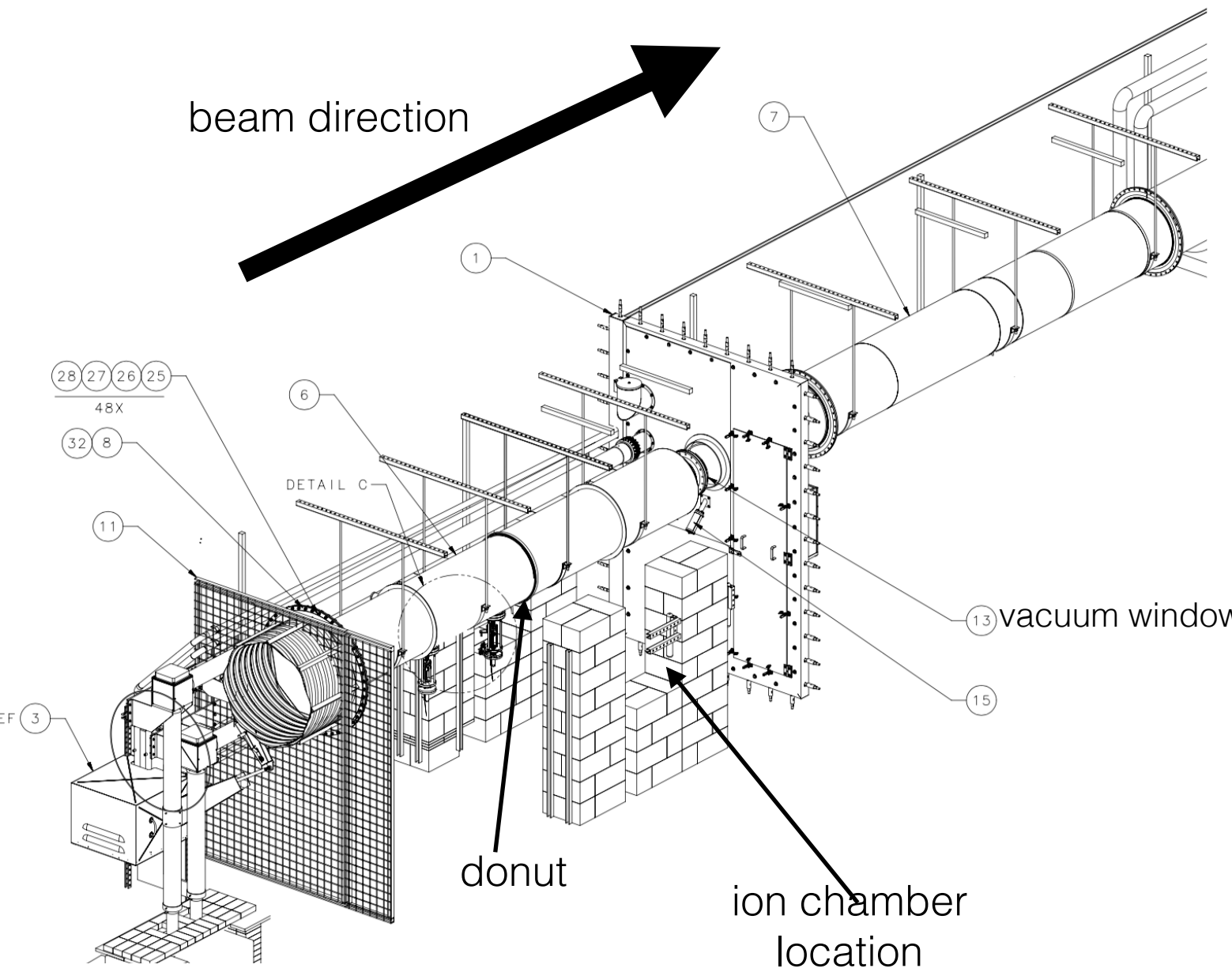
HRS power supply	PREX-I	PREX-II	CREX	P2/P1	CREX/P1	P2/H2	P2/PVDIS
neutron	1.0E+11	7.6E+09	1.5E+10	7%	20%	70%	73%
electron	1.2E+11	1.4E+10	2.1E+10	11%	12%	94%	84%
<b>total</b>	<b>2.3E+11</b>	<b>2.1E+10</b>	<b>3.6E+10</b>	<b>9%</b>	<b>16%</b>	<b>83%</b>	<b>80%</b>

NIEL thresholds: Semiconductor damage  $\sim 10^{13}$ , Optocoupler damage  $\sim 10^{11}$

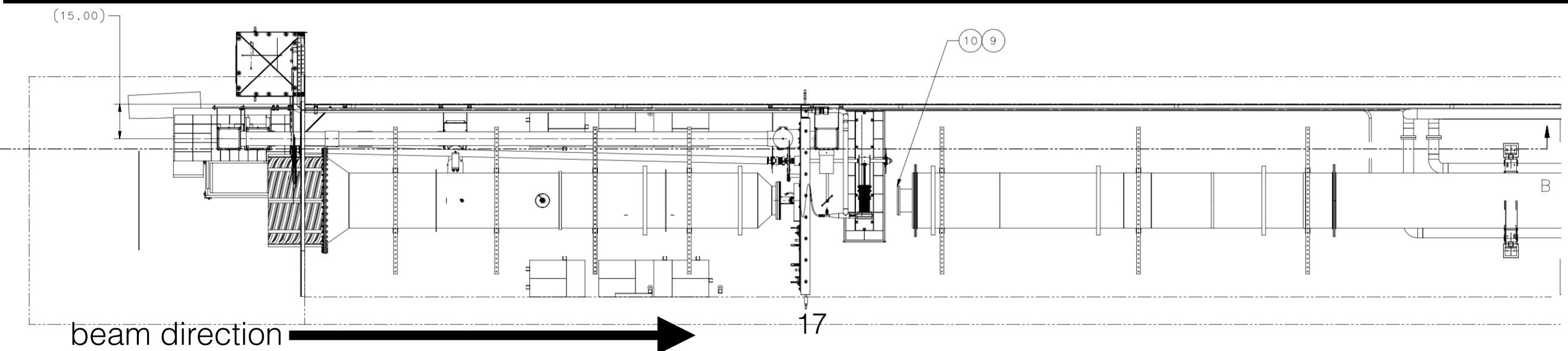
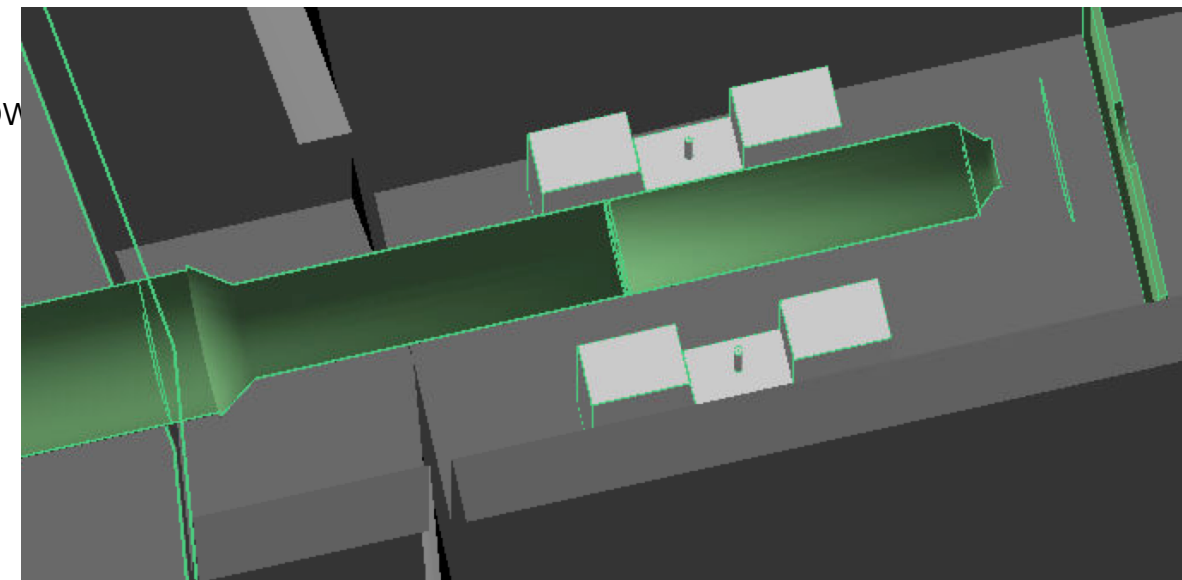


- Focus for design of PREX2 and CREX was successfully cleaning up the radiation from the target and collimator
- We used the same dump configuration for our simulations of PREX2 and CREX
  - We were unaware of changes made to the dump, so we expected our estimate to be reasonable

# Current Hall A Dump configuration



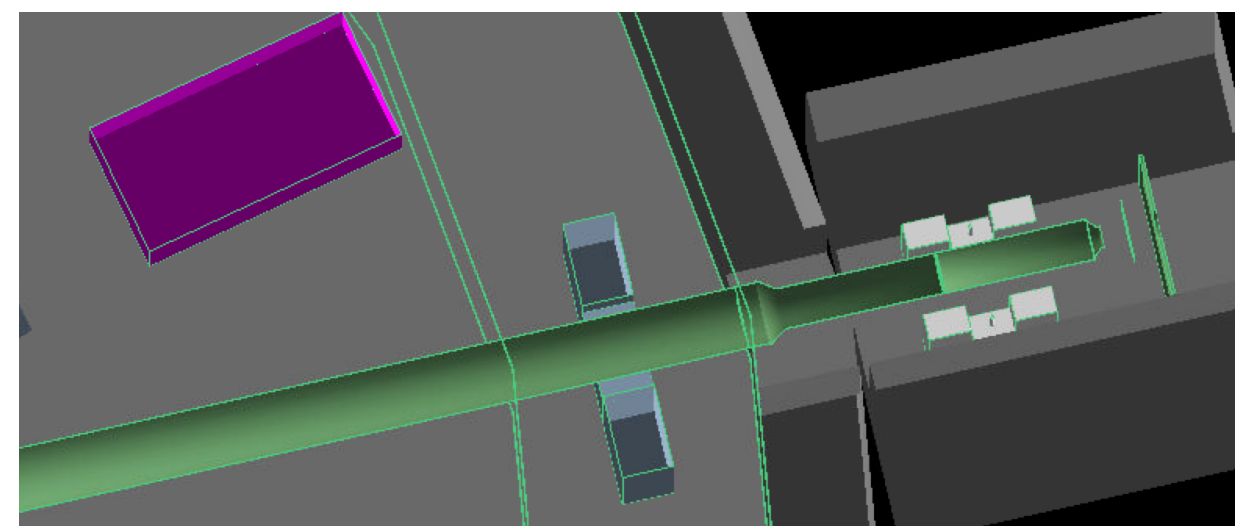
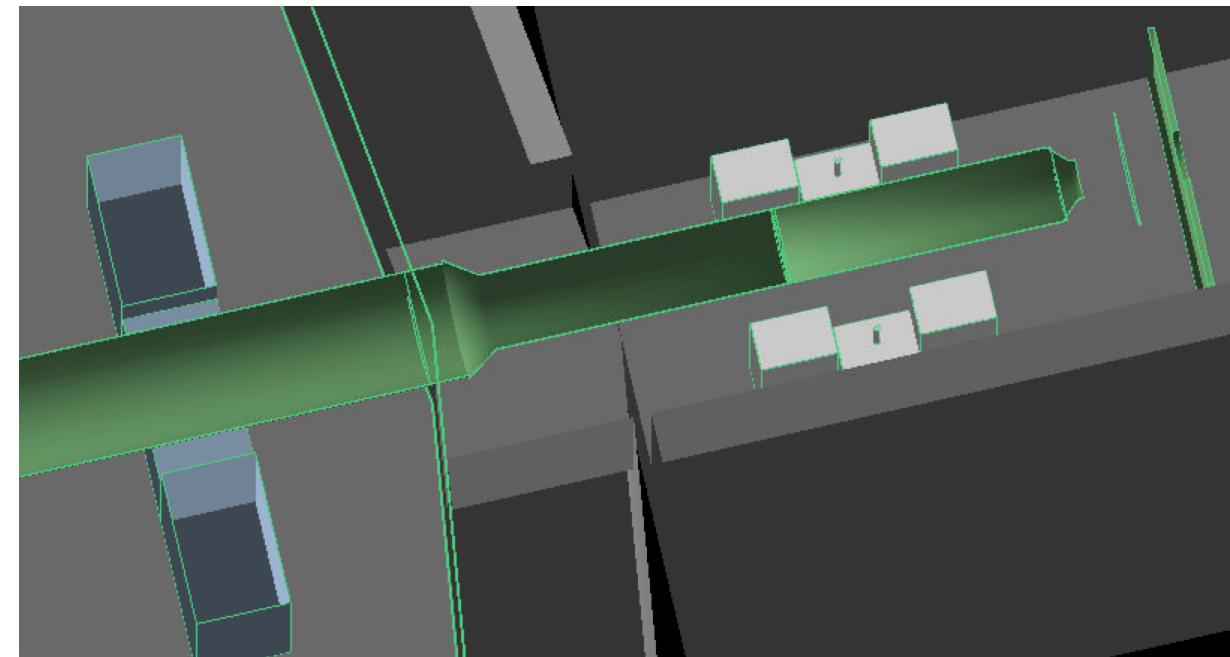
- For PREX2/CREX we will not need to use the diffuser
- We implemented the major features of the current design in the simulation
  - including the 4 cm Al aperture at ~midway until the Al door



# Updated PREX2 and CREX estimates

	P2/P1 (ERR)	C/P1 (ERR)	P2/P1 (now)	C/P1 (now)	C(4in)/ P1	P2(2ft)/ P1
ratio to PREX 1	0.09	0.16	1.25	0.84	0.20	0.33

- The current dump configuration presents 2 problems:
  - the neck down intercepts scattered electrons (this is a problem for PREX2)
  - the aperture intercepts significantly more electrons than in the previous configuration (part of the problem for PREX2, the big issue for CREX)
- Increasing the aperture by ~6 cm (to the old 4in level) the CREX problem is basically solved
- Adding 2 feet of concrete to block the entire line of sight to the HRS detector reduces the PREX2 dose significantly
  - This base shielding design would be possible within the geometrical constraints inside the hall @12.5 deg





# Conclusions and optimization plans

- The current dump configuration has the potential to produce significant radiation doses to the HRS electronics platform
- We have identified a 0th order mitigation scheme
  - optimization will follow (material, position, size)
- We plan to add the rest of the dump in the simulation to ensure nothing else could cause an issue

# Radiation - entire run values

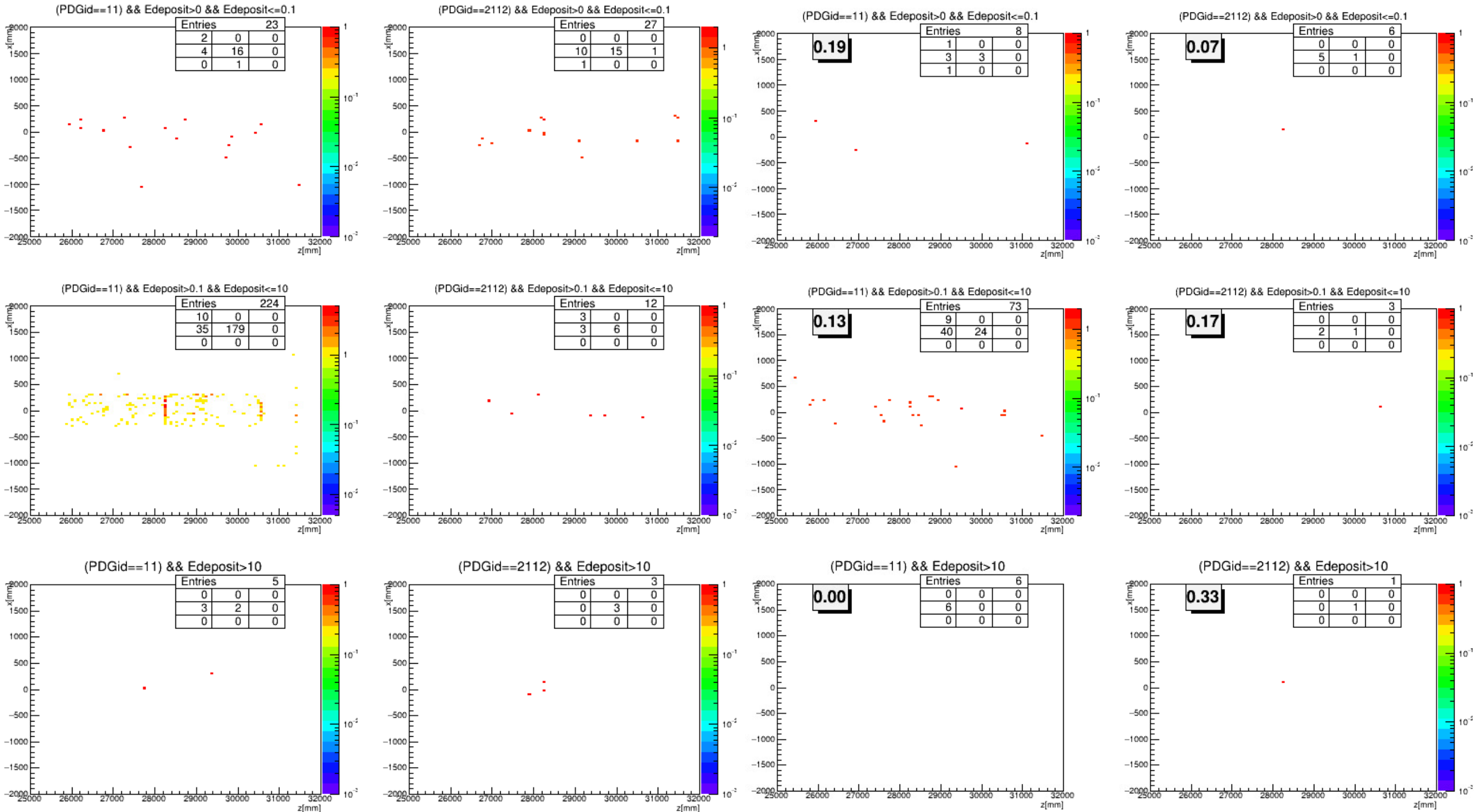
	HRS detector				Under detector			
	Total NEIL/cm2	uncert	Ratio to P1	uncert	Total NEIL/cm2	uncert	Ratio to P1	uncert
PREX1 (ERR dump)	4.60E+10	1.79E+09	1.00	0.06	7.43E+10	4.92E+09	1.00	0.09
PREX1 (actual dump)	4.05E+10	1.68E+09	0.88	0.05	7.78E+10	5.39E+09	1.05	0.10
PREX2 ERR	4.96E+09	6.72E+08	0.11	0.02	1.09E+10	2.61E+09	0.15	0.04
PREX2 current	5.77E+10	5.69E+09	1.25	0.13	7.60E+10	1.85E+10	1.02	0.26
P2 with P1pipe	2.12E+10	3.38E+09	0.46	0.08	4.39E+10	1.31E+10	0.59	0.18
P2 current+4in	4.46E+10	4.64E+09	0.97	0.11	6.68E+10	1.45E+10	0.90	0.20
P2 current+Conc	2.38E+10	3.44E+09	0.52	0.08	2.76E+10	1.04E+10	0.37	0.14
P2 current+ (Conc*2)	1.54E+10	1.81E+09	0.33	0.04	1.72E+10	4.07E+09	0.23	0.06
P2 current+ (Conc*0.5)	2.70E+10	2.63E+09	0.59	0.06	2.40E+10	6.13E+09	0.32	0.09
P2 current+Poly	2.19E+10	3.09E+09	0.48	0.07	5.40E+10	1.59E+10	0.73	0.22
P2 current+4in+1ftCont	1.83E+10	2.84E+09	0.40	0.06	2.69E+10	7.95E+09	0.36	0.11
P2 current + donut shield	5.27E+10	5.61E+09	1.15	0.13	8.28E+10	1.98E+10	1.11	0.28
CREX ERR	6.73E+09	2.05E+09	0.15	0.04	1.31E+10	6.57E+09	0.18	0.09
C5 current	3.86E+10	7.80E+09	0.84	0.17	4.70E+10	1.96E+10	0.63	0.27
C5 current+4in	9.86E+09	2.61E+09	0.21	0.06	3.80E+10	2.11E+10	0.51	0.29
C5 P1pipe	7.31E+10	1.12E+10	1.59	0.25	1.06E+11	3.38E+10	1.43	0.47
C5 current+Conc	2.23E+10	5.78E+09	0.49	0.13	3.21E+10	1.65E+10	0.43	0.22
C5 current+(Conc*2)	1.73E+10	3.23E+09	0.38	0.07	2.68E+10	1.00E+10	0.36	0.14
C5 current+(Conc*0.5)	1.70E+10	3.35E+09	0.37	0.07	1.09E+10	5.20E+09	0.15	0.07
C5 current+Poly	1.86E+10	5.13E+09	0.40	0.11	1.40E+10	1.01E+10	0.19	0.14
C5 current+ 2Pipe septum	3.85E+10	8.70E+09	0.84	0.19	9.65E+10	3.52E+10	1.30	0.48
C5 current+ 4in+1ftConc	1.01E+10	3.28E+09	0.22	0.07	3.85E+10	2.35E+10	0.52	0.32
C5 current+2Pipe+donut shield	4.09E+10	7.86E+09	0.89	0.17	4.73E+10	2.41E+10	0.64	0.33

**Area for HRS det: 4e5 cm<sup>2</sup>**  
**Area for Under det: 6e4 cm<sup>2</sup>**

# PREX2 - Under HRS detector

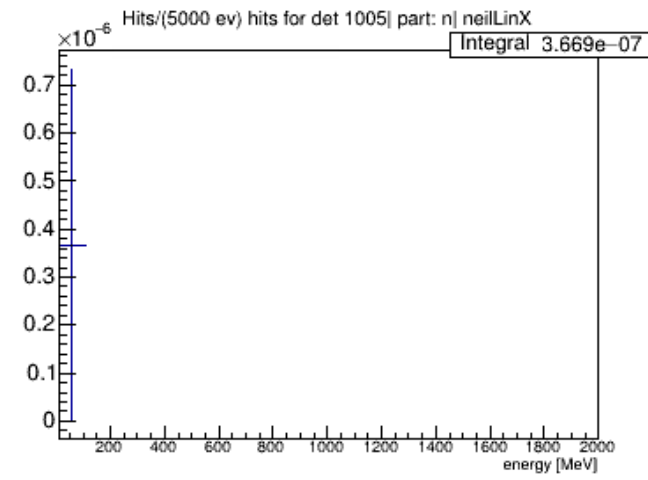
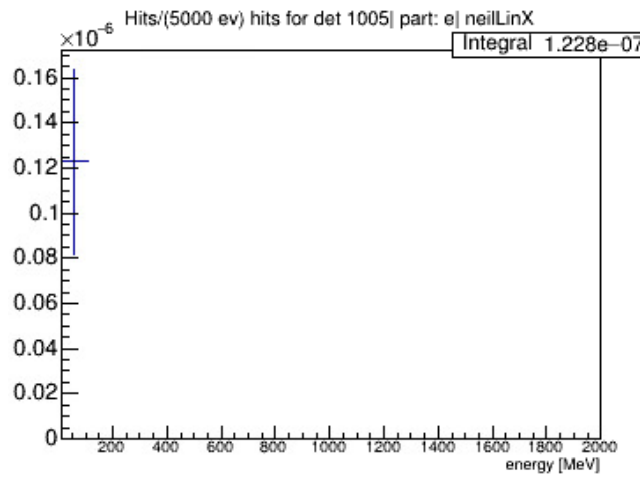
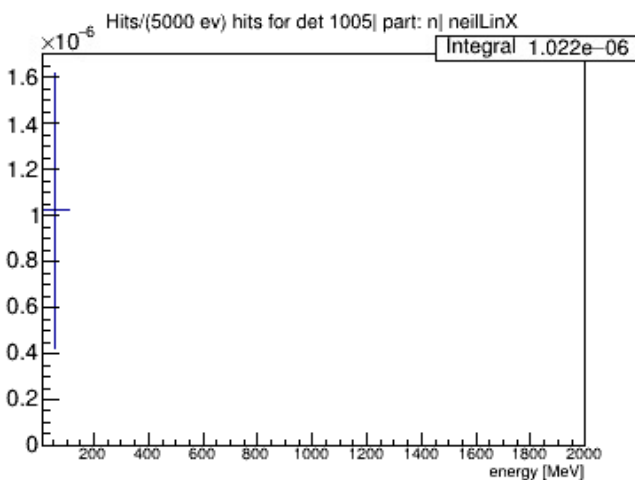
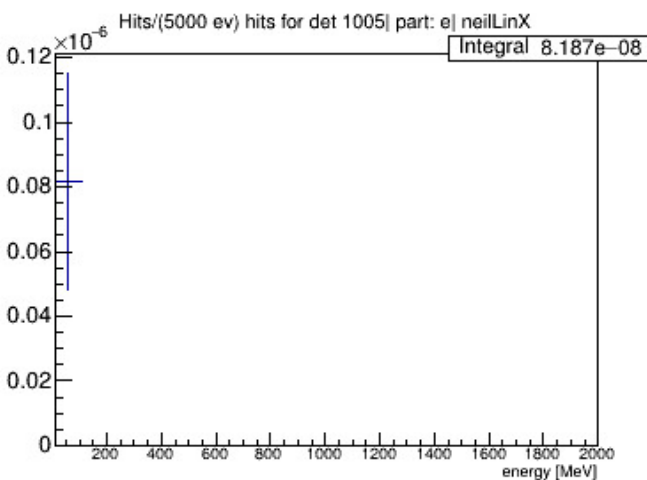
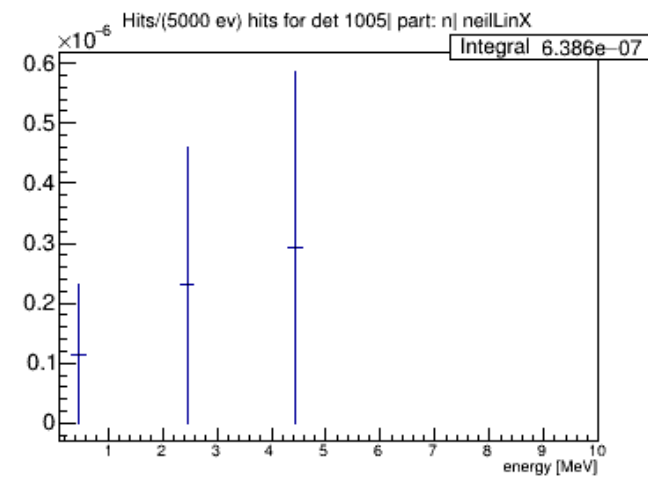
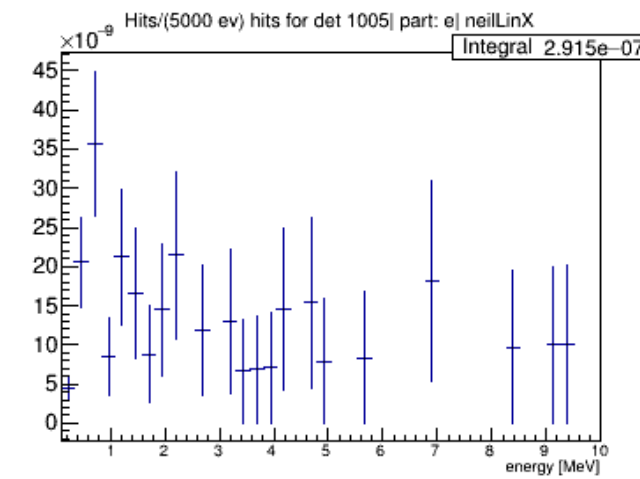
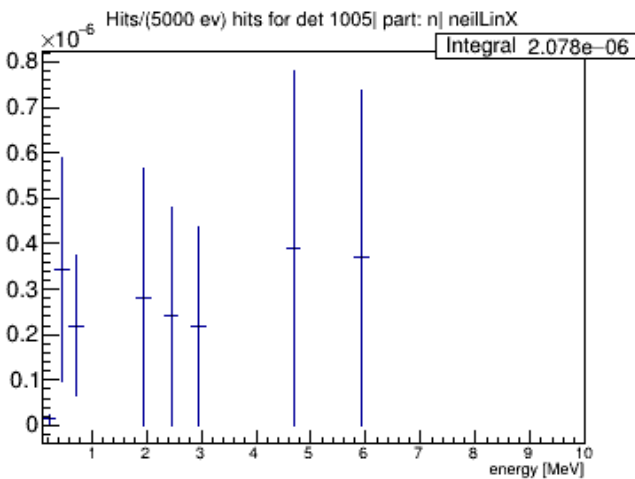
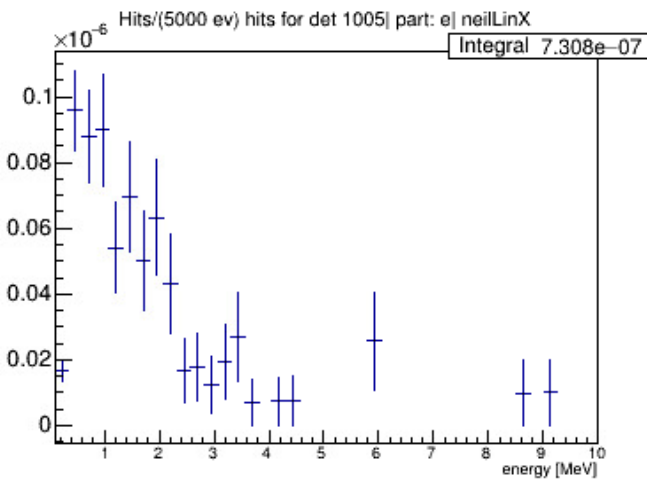
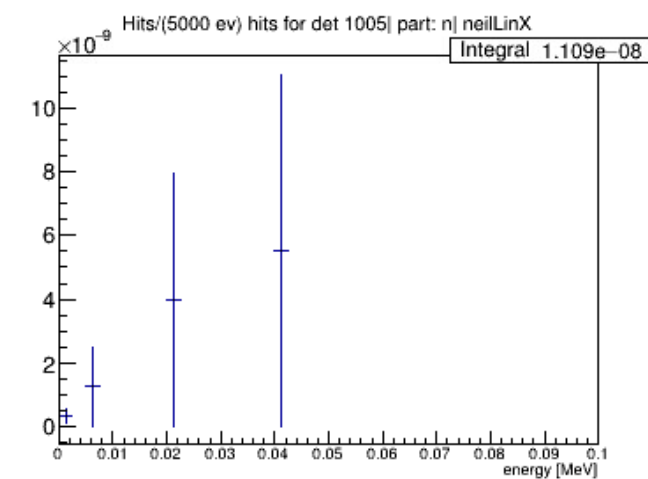
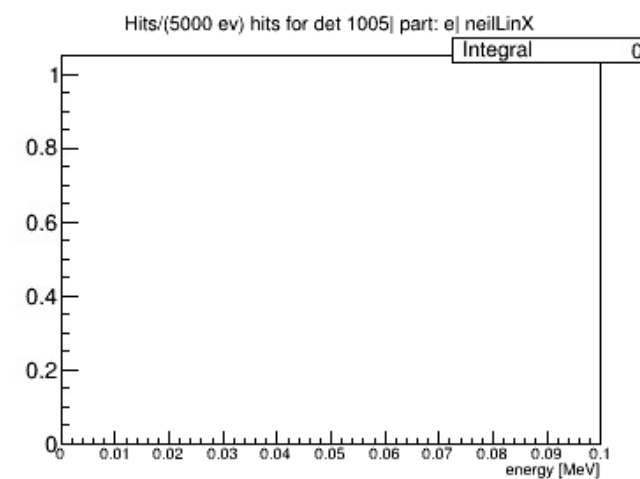
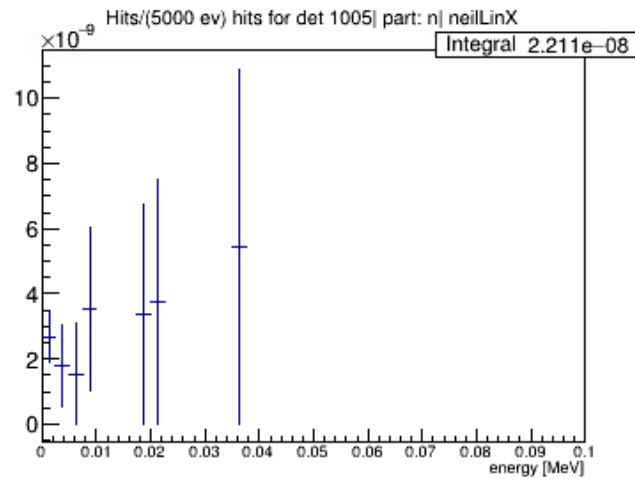
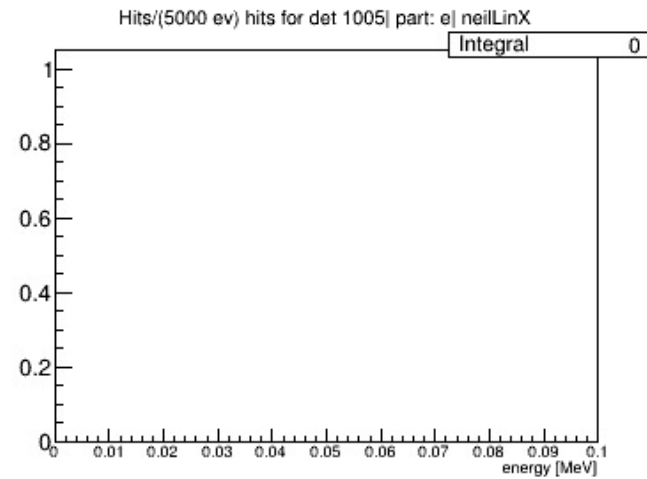
current setup

current setup + 1 ft Concrete



# PREX2 - Under HRS detector

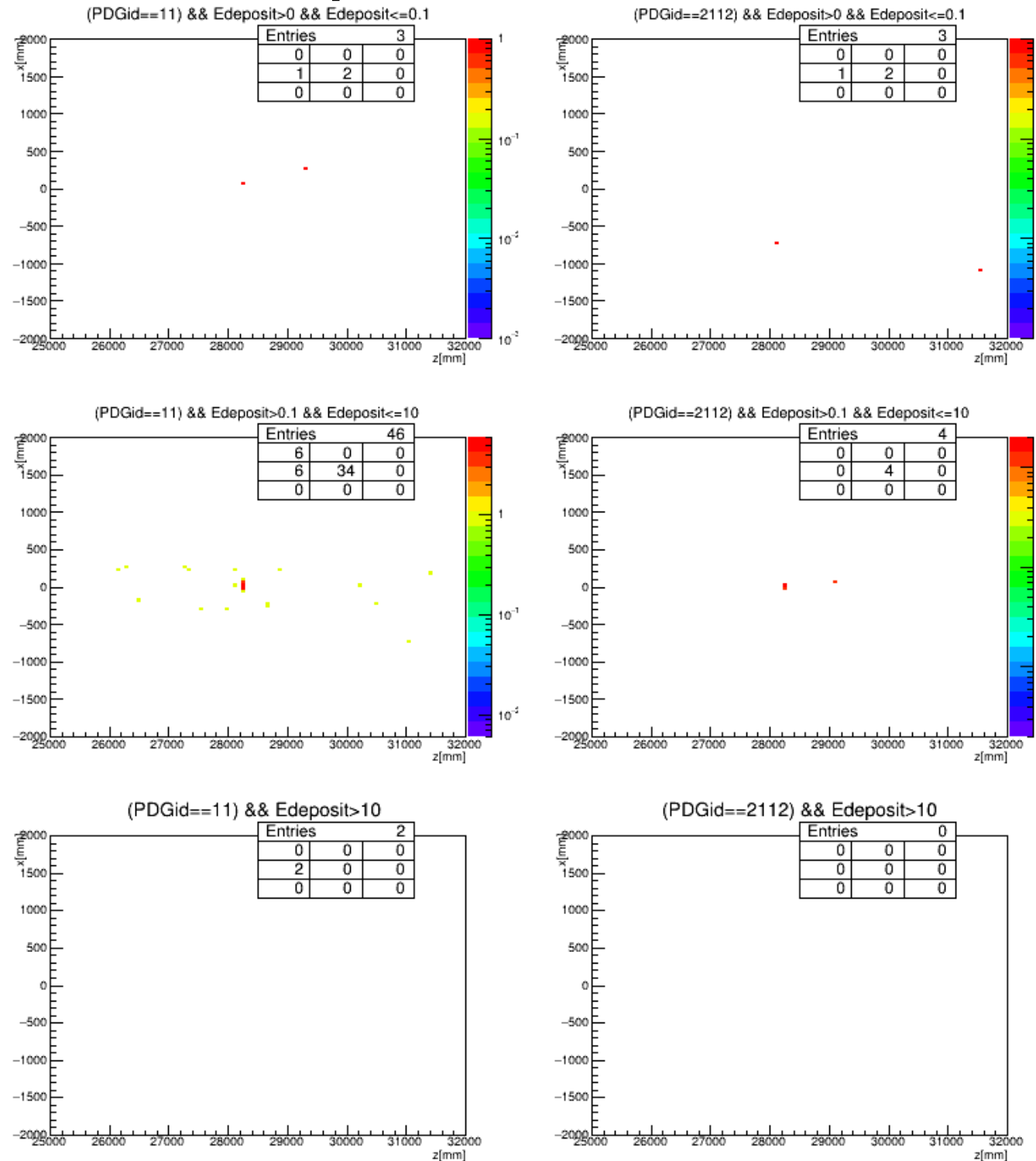
## current setup



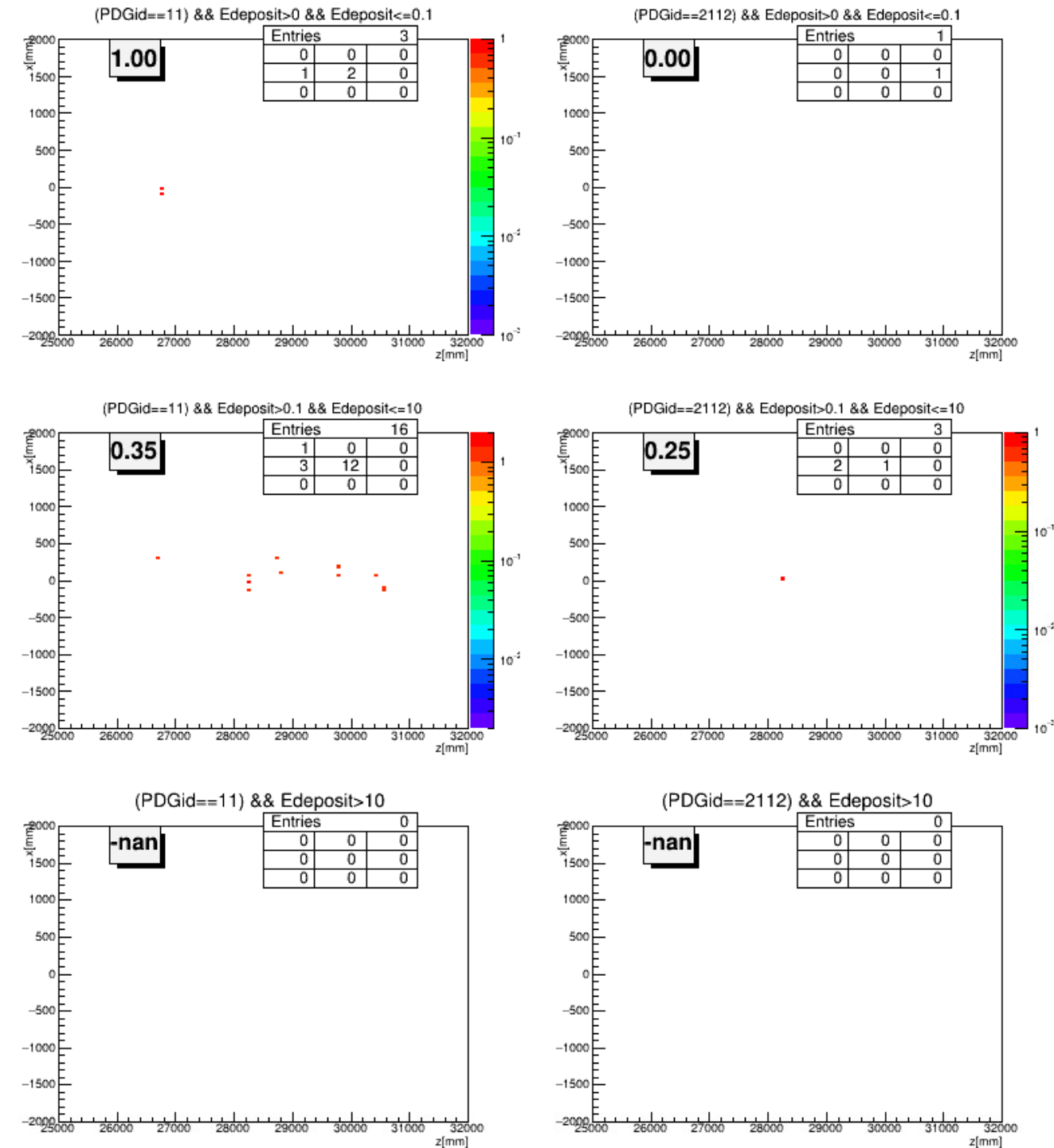
## current setup + 1 ft Concrete

# CREX - Under HRS detector

## current setup

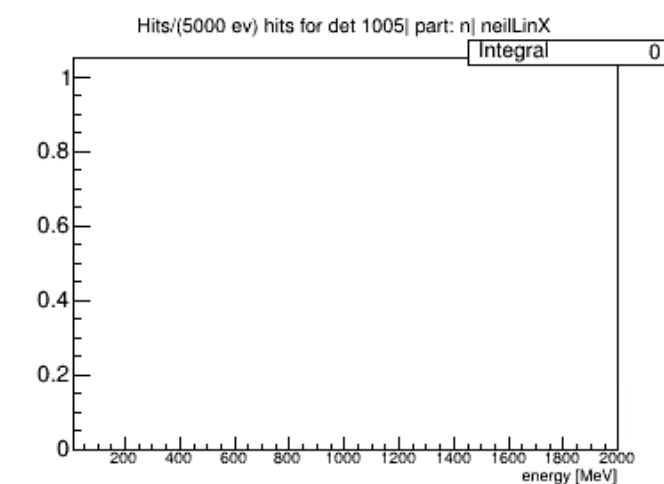
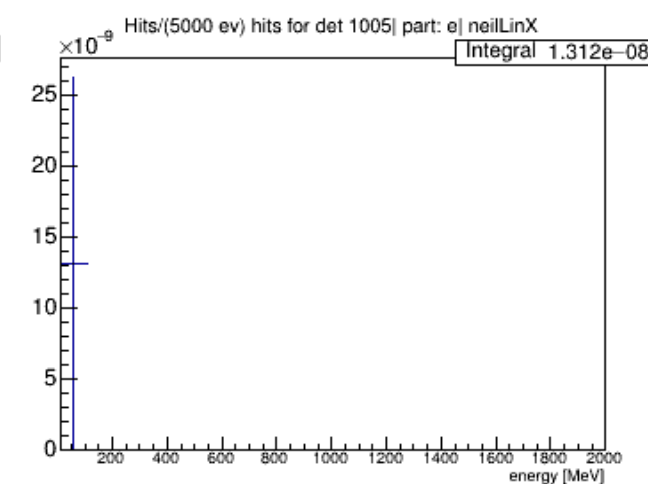
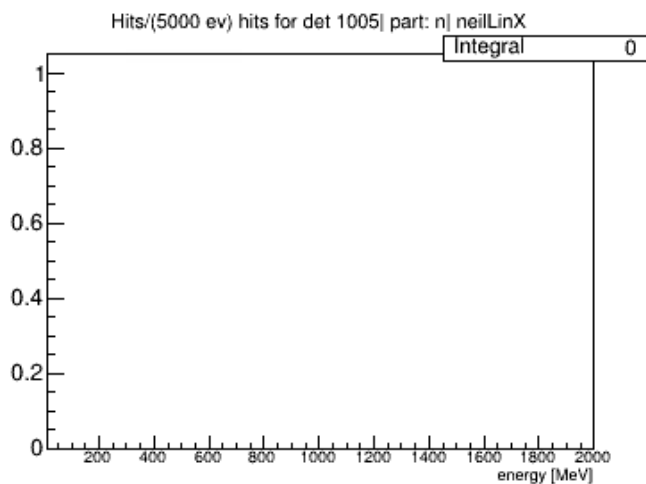
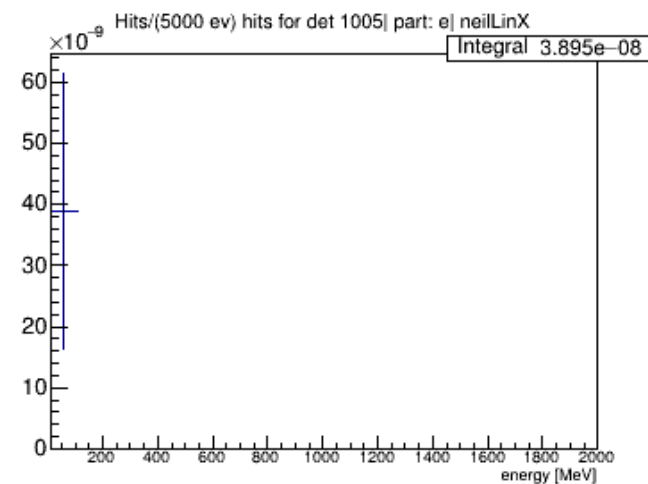
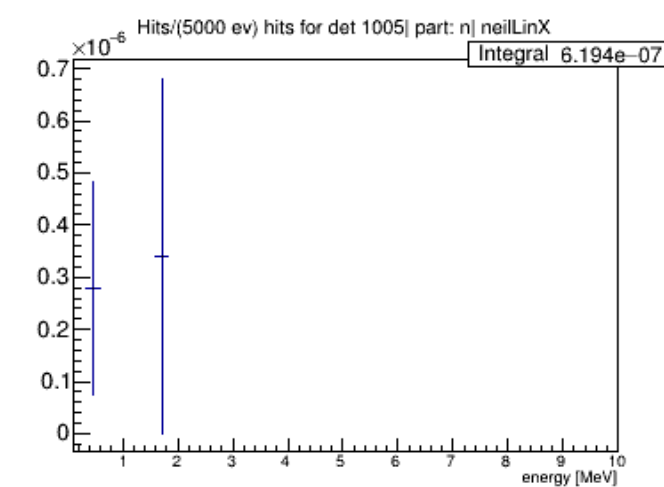
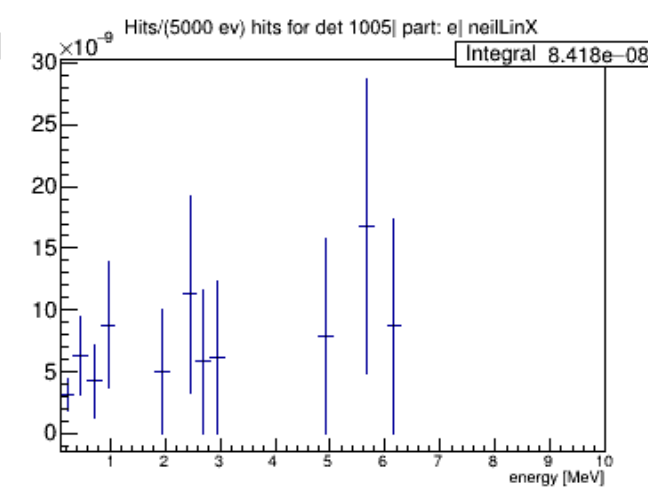
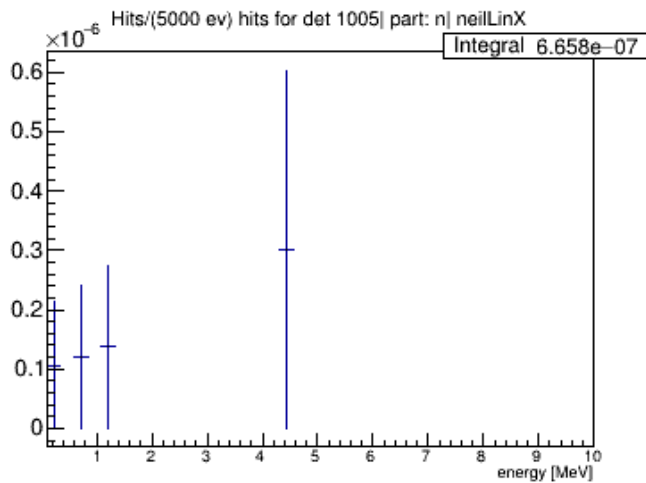
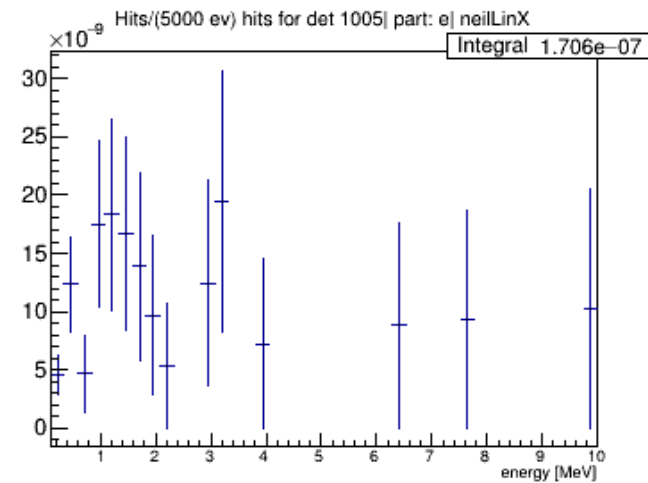
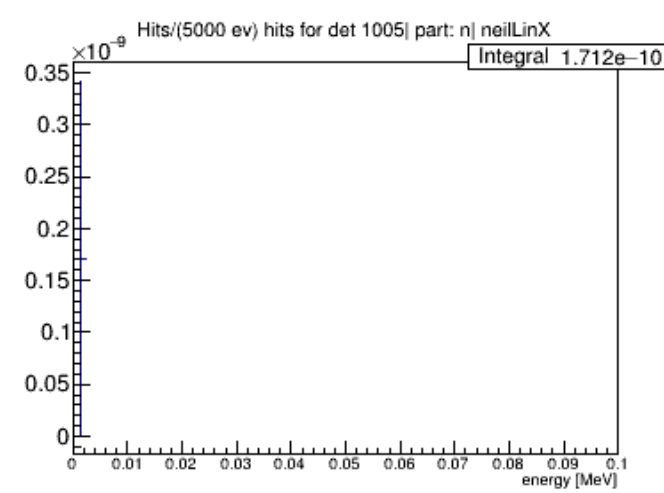
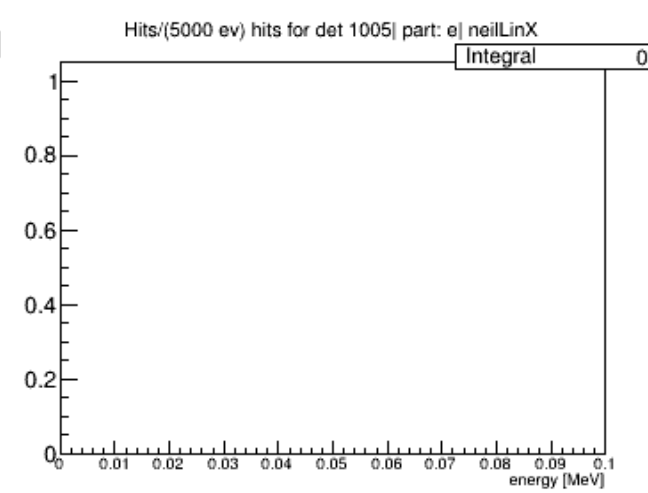
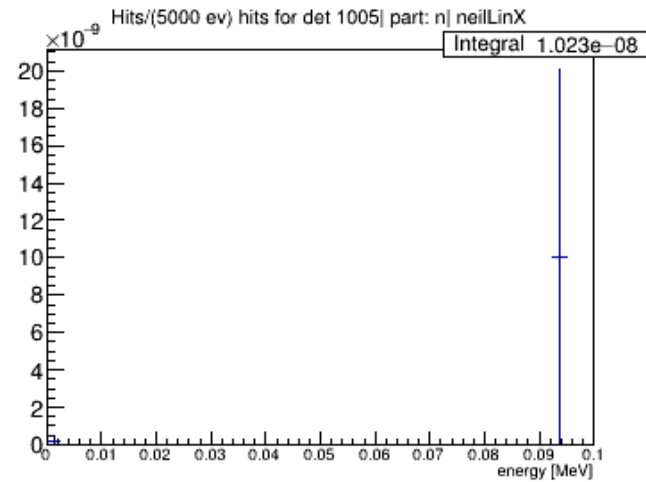
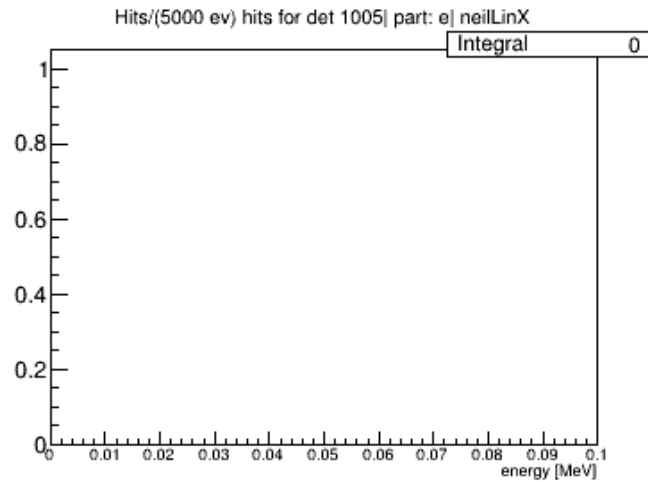


## current setup + 1 ft Concrete



# CREX - Under HRS detector

## current setup

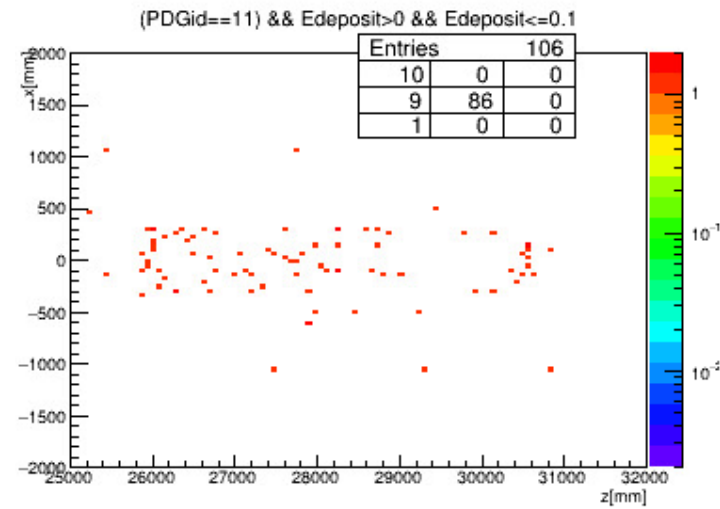


## current setup + 4 in donut

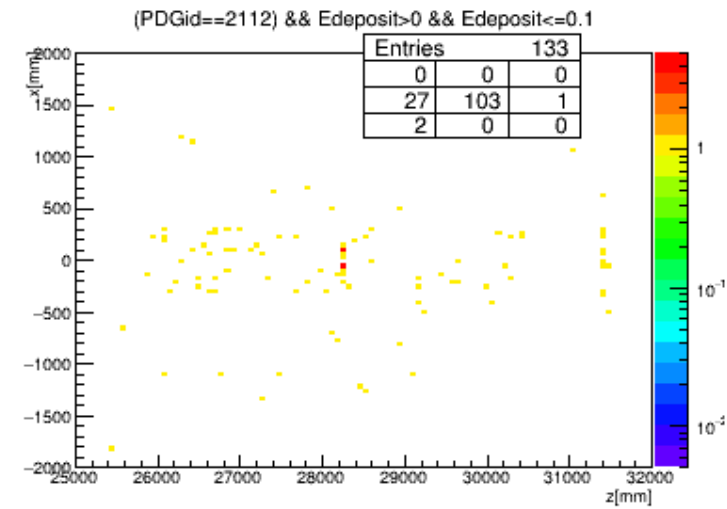


# PREX2 - current dump

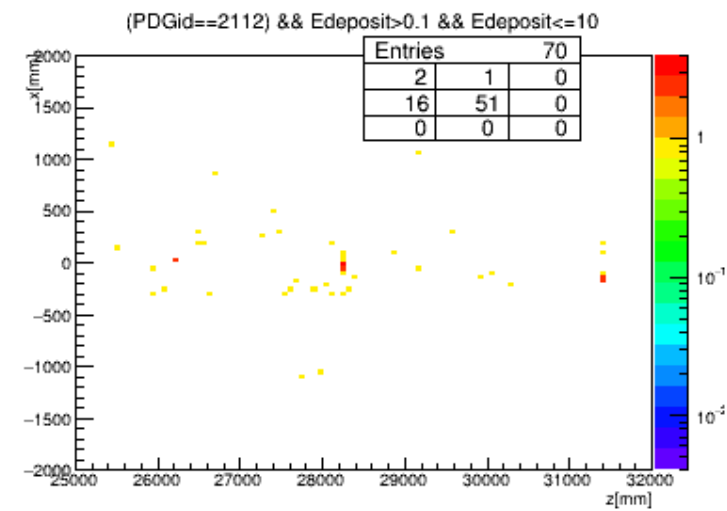
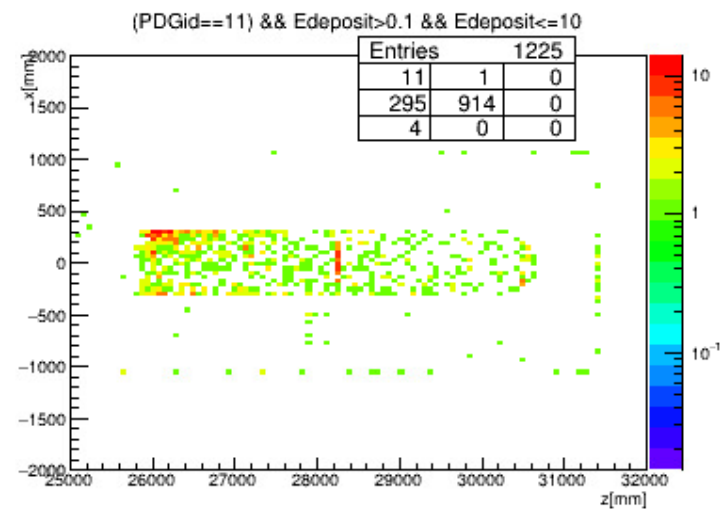
electrons



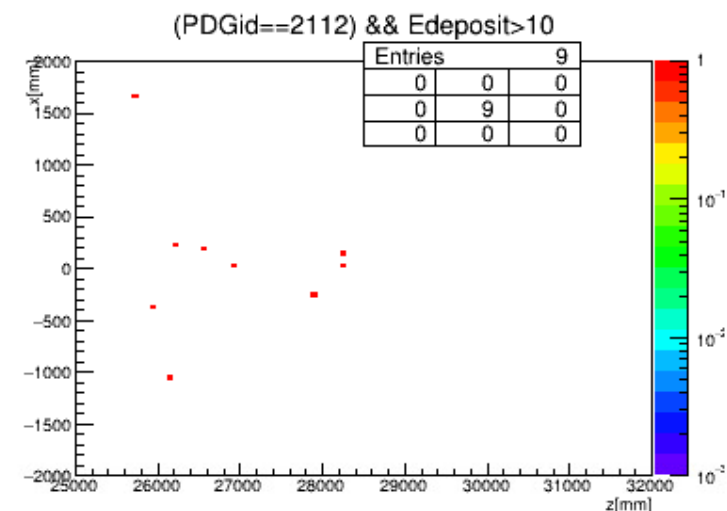
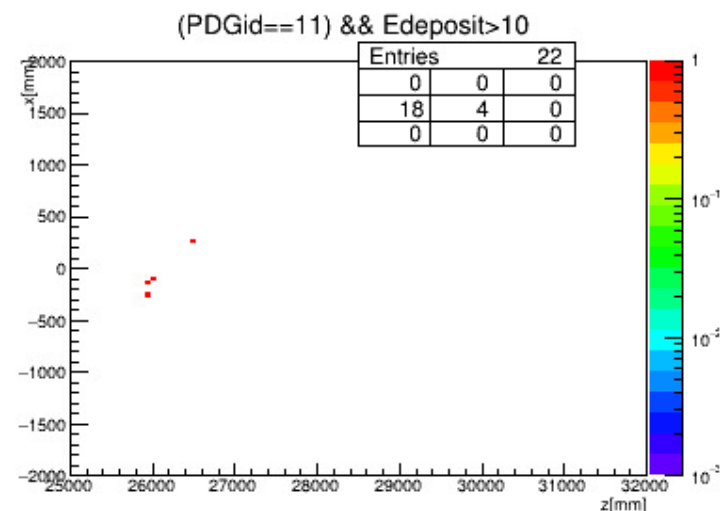
neutrons



$0 < E \leq 0.1$  MeV



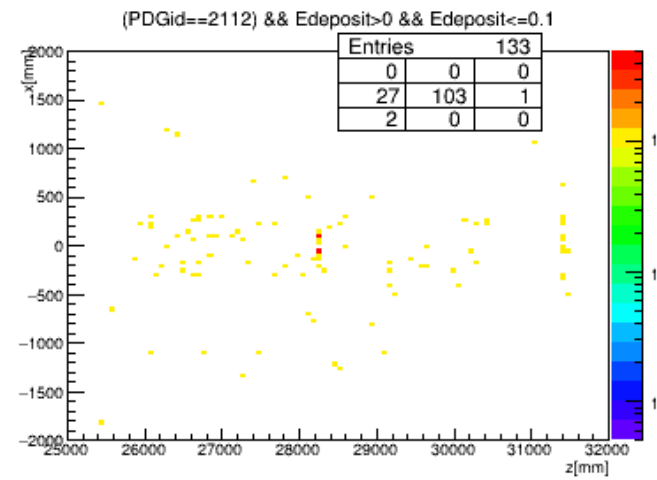
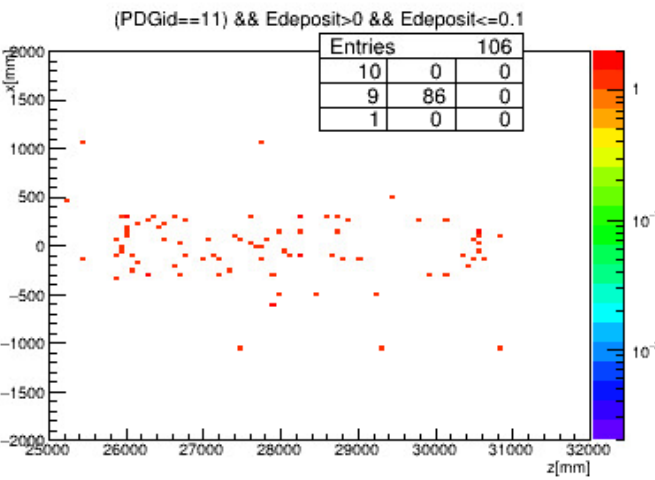
$0.1 < E \leq 10$  MeV



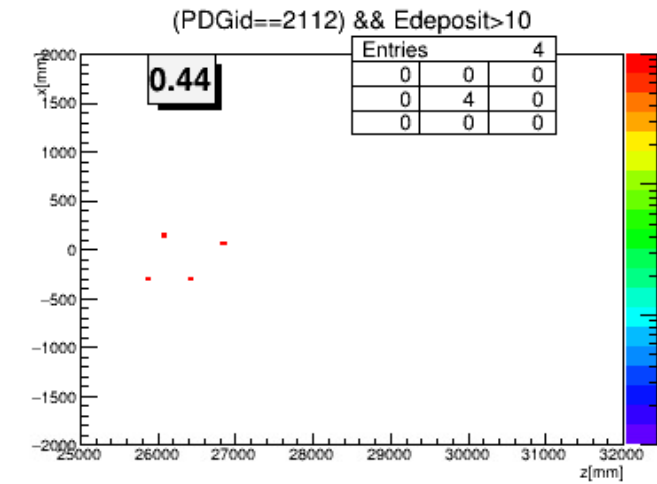
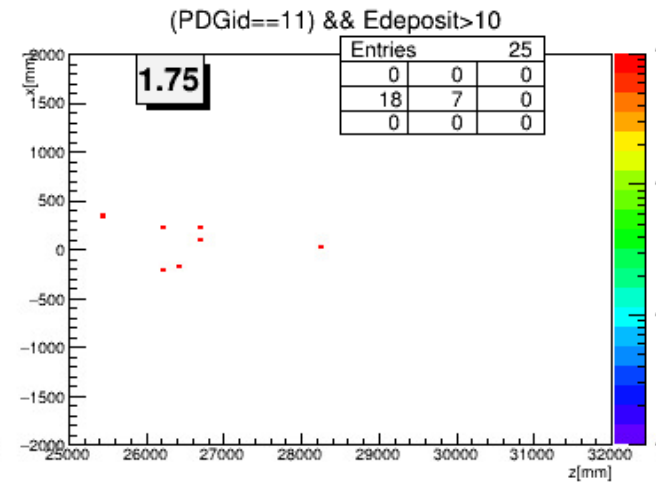
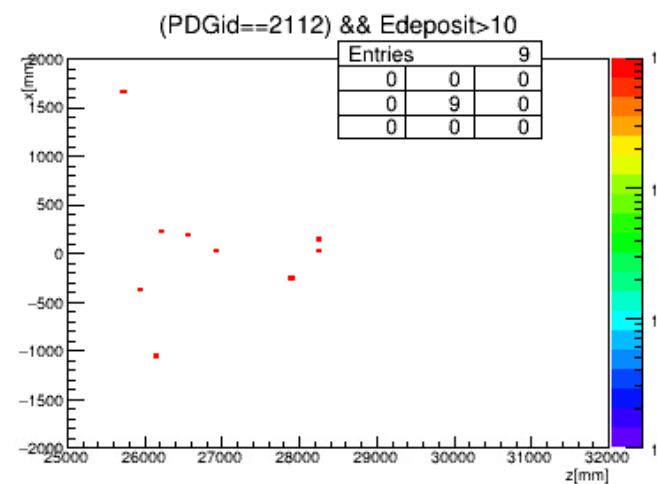
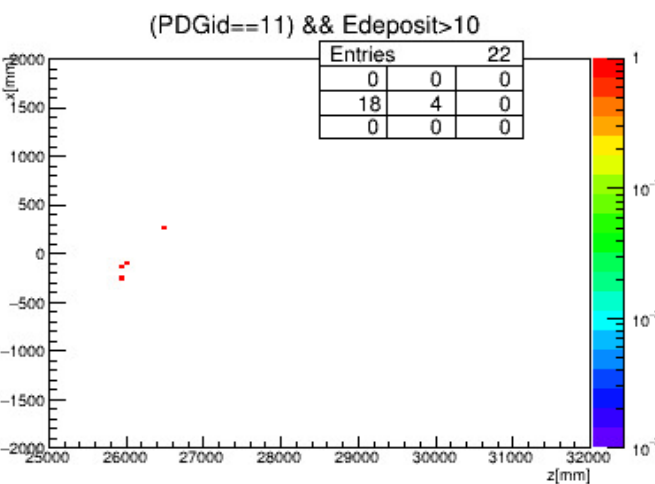
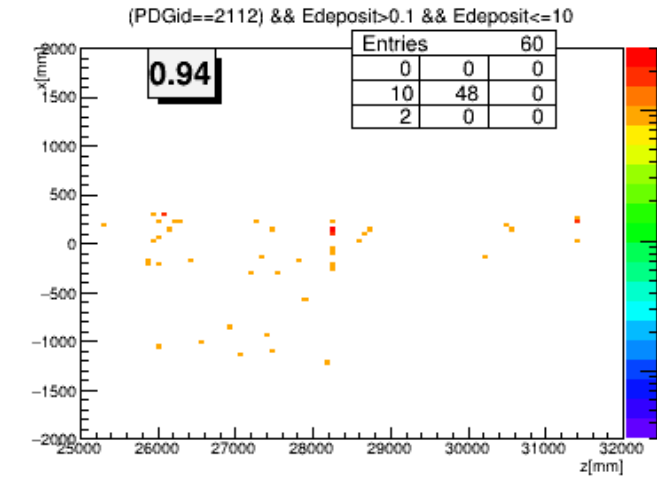
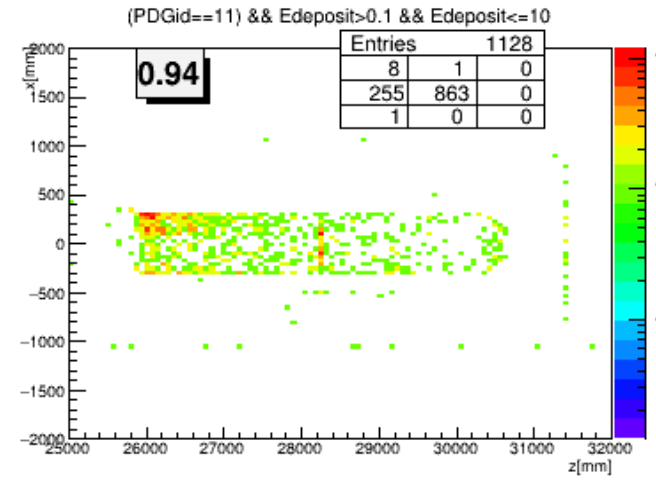
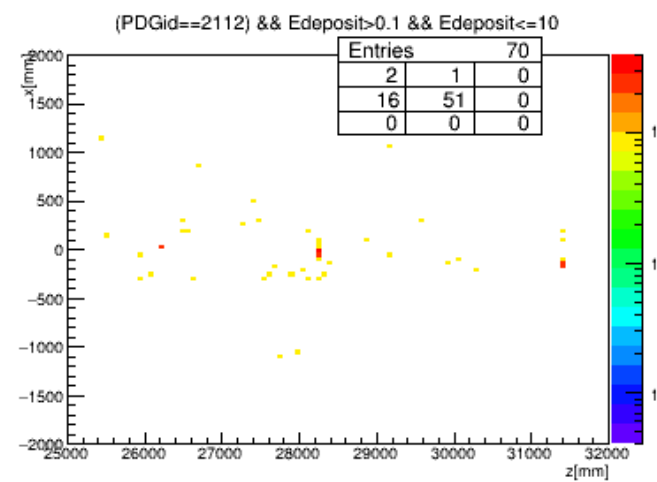
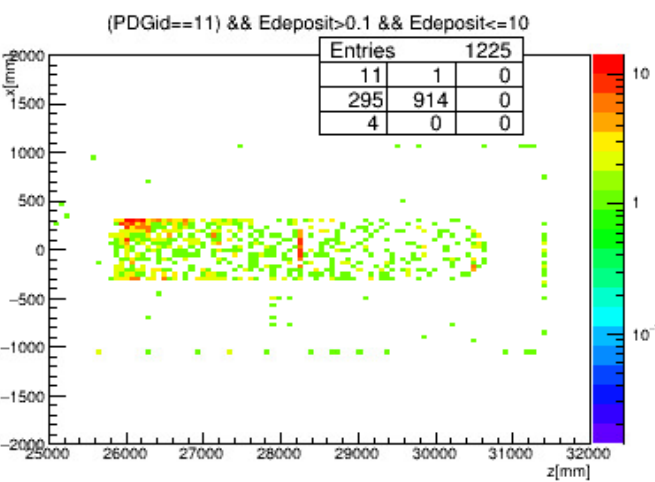
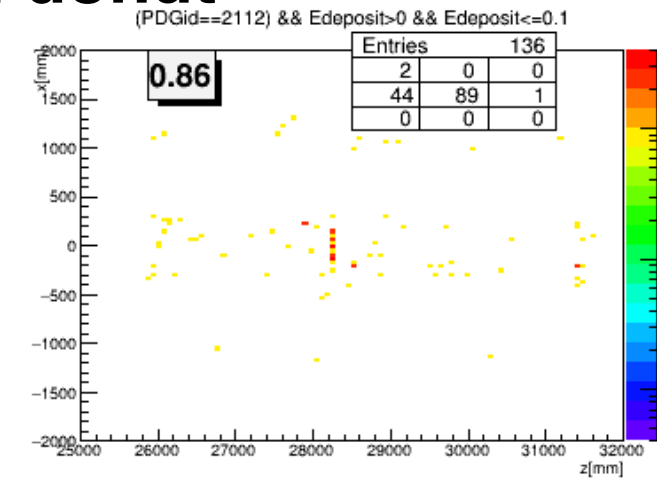
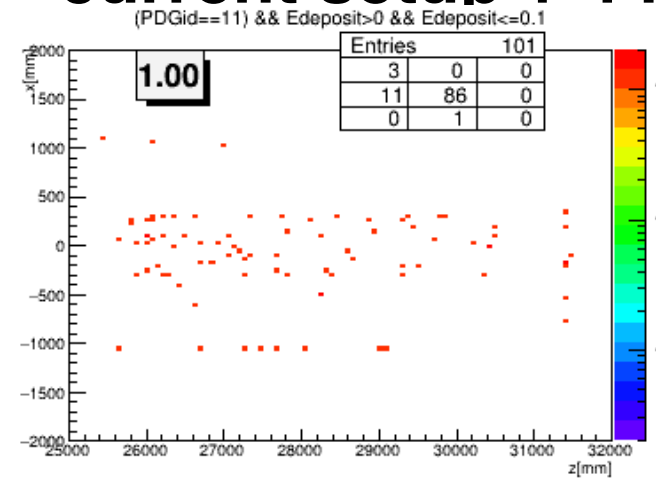
$10 < E$  MeV

# PREX2 - comparison

## current setup



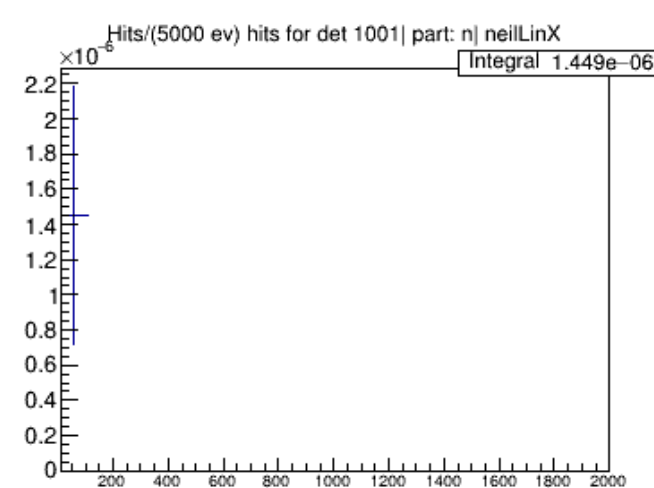
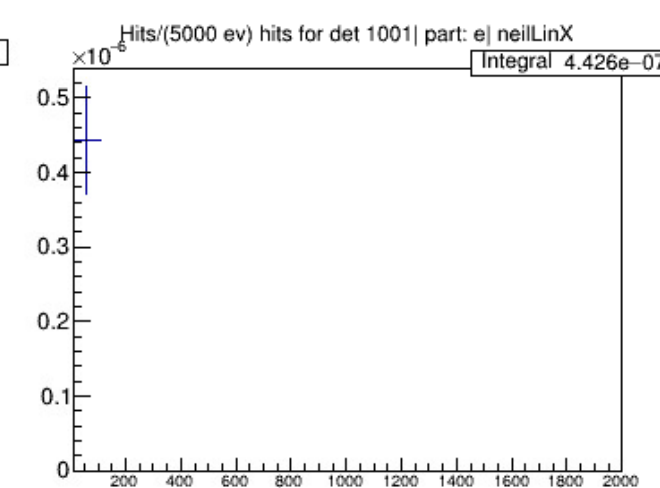
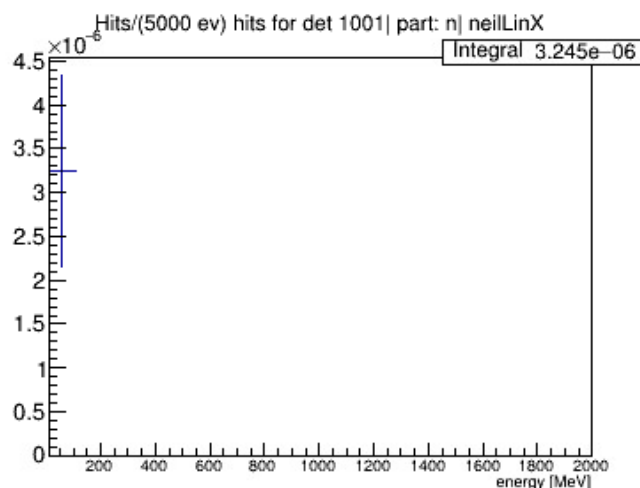
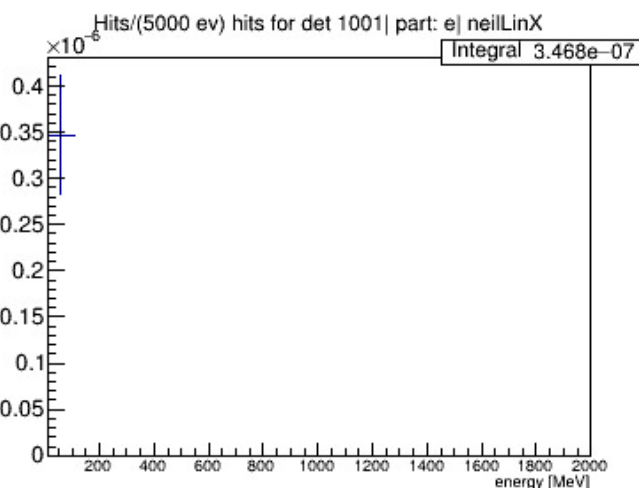
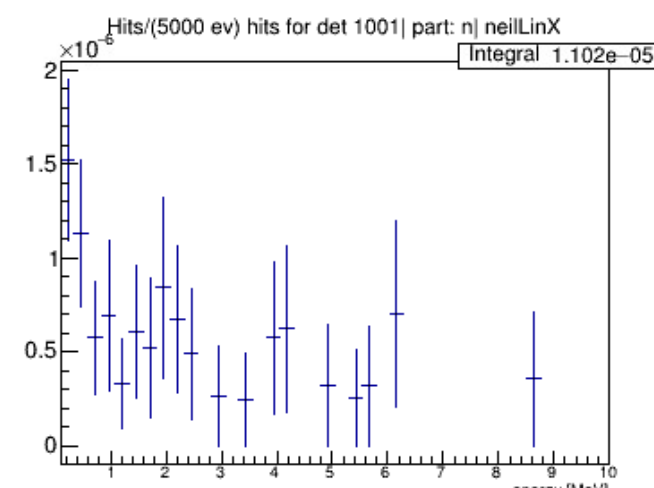
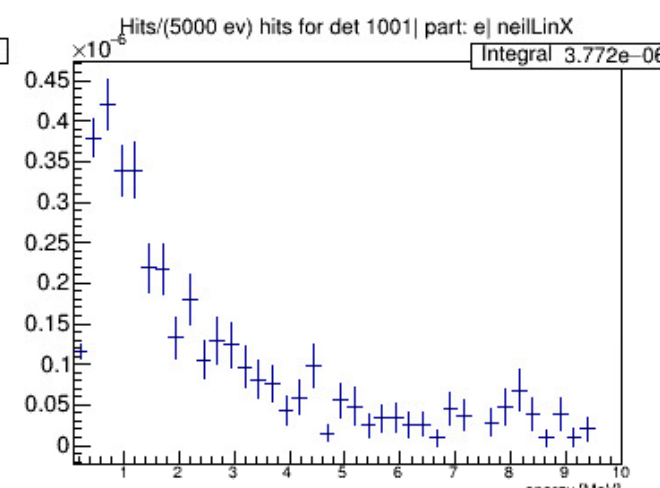
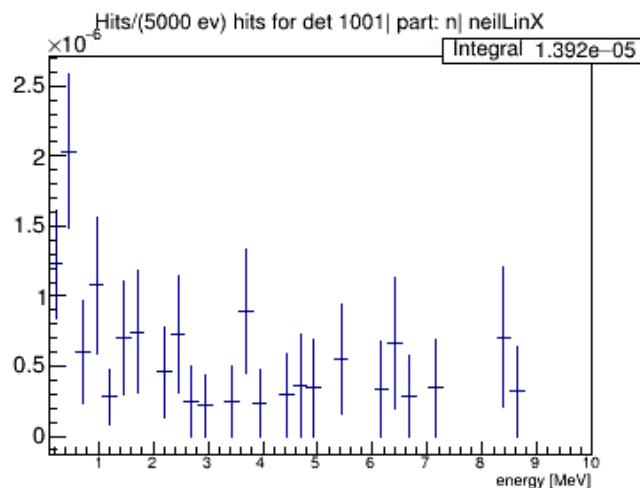
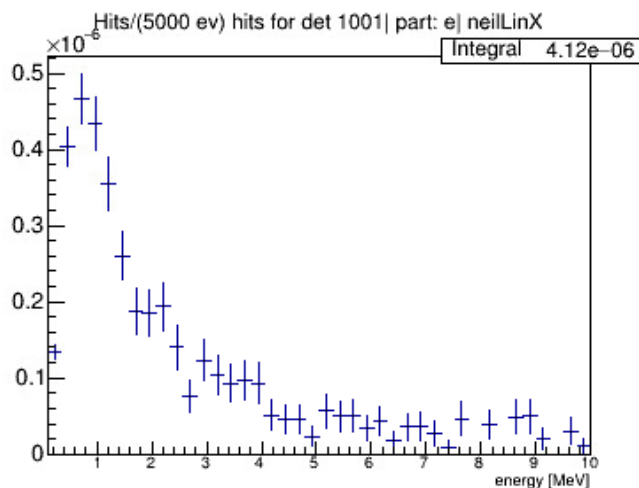
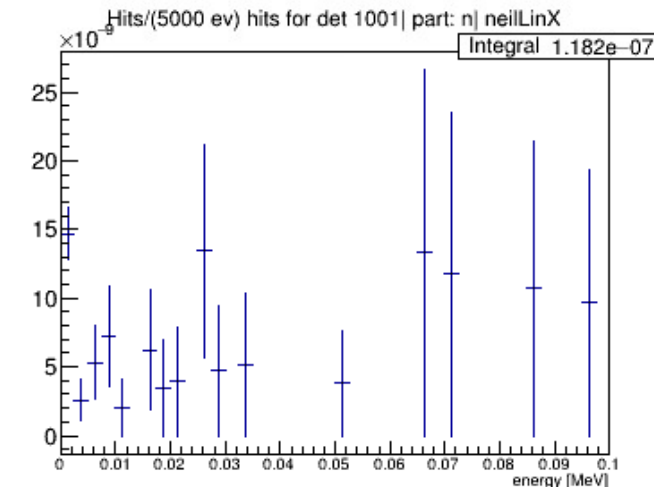
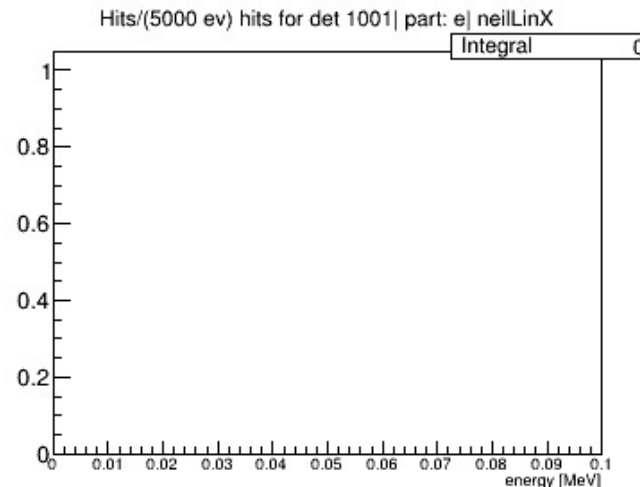
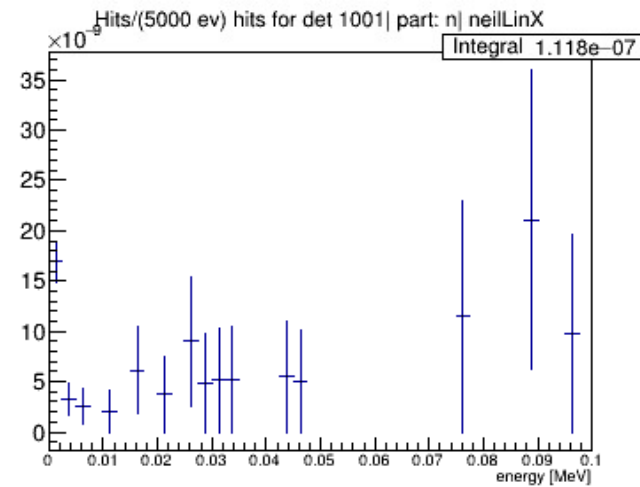
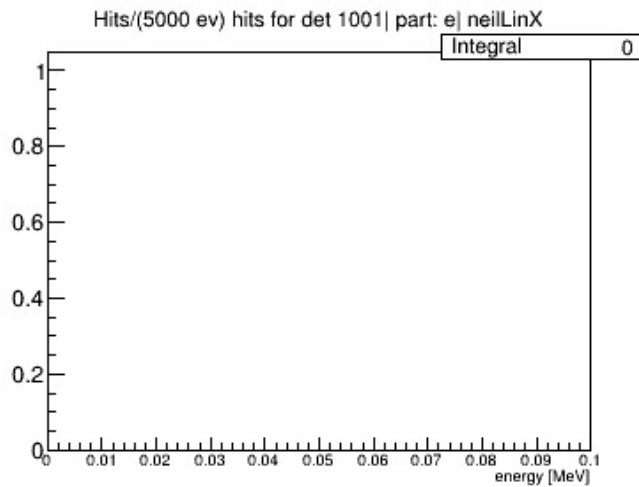
## current setup + 4 in donut





# PREX2 - comparison

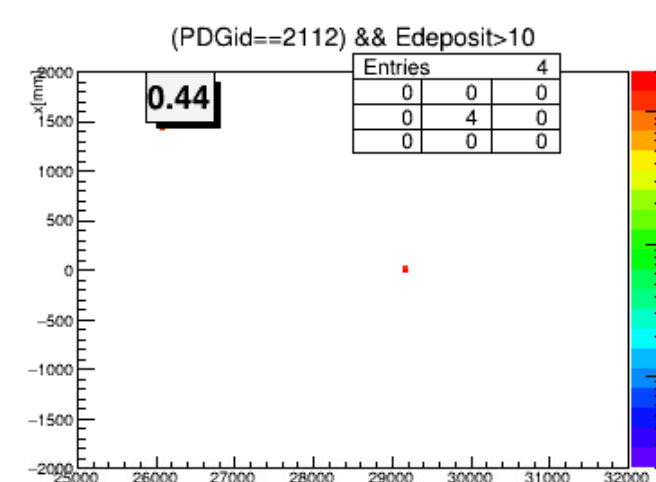
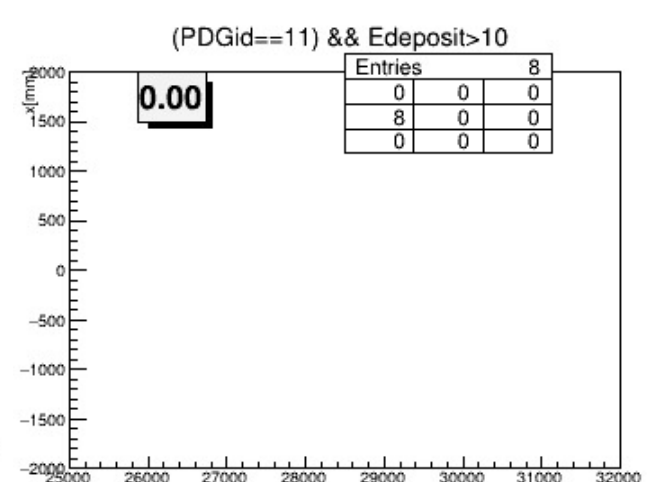
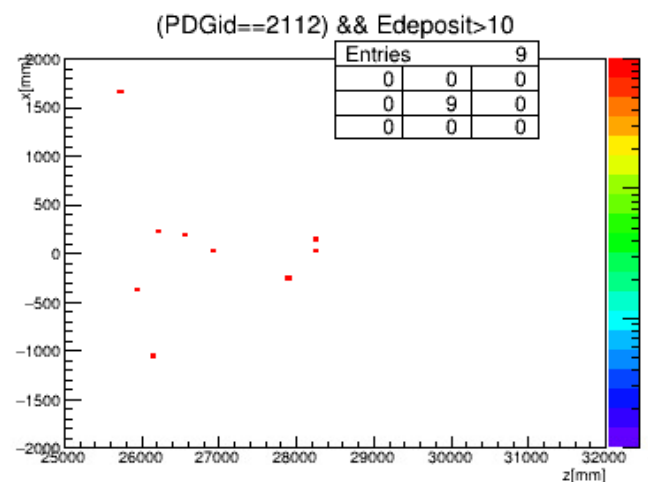
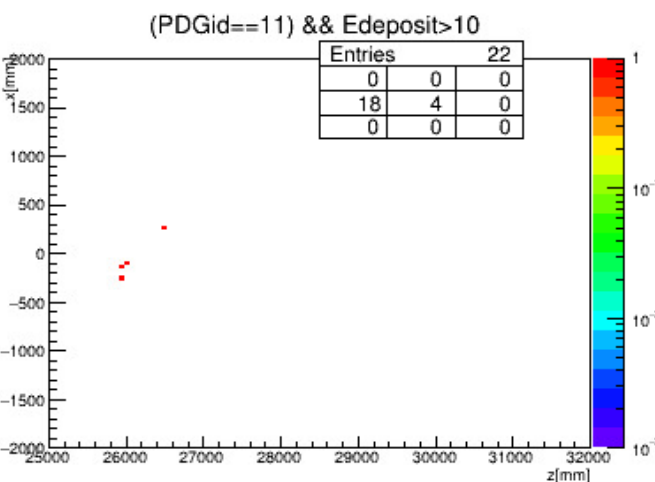
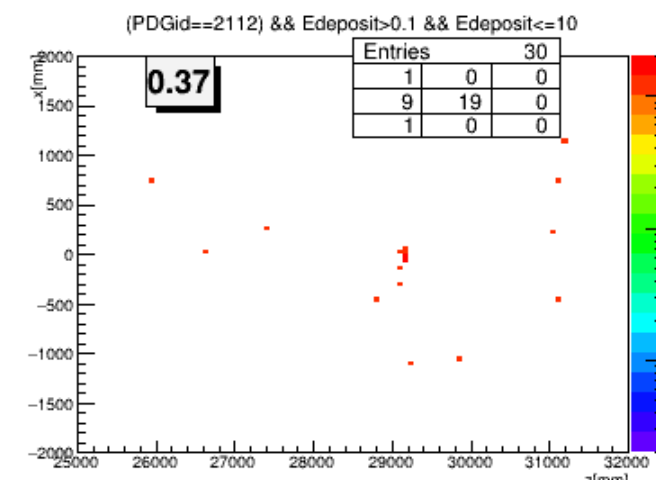
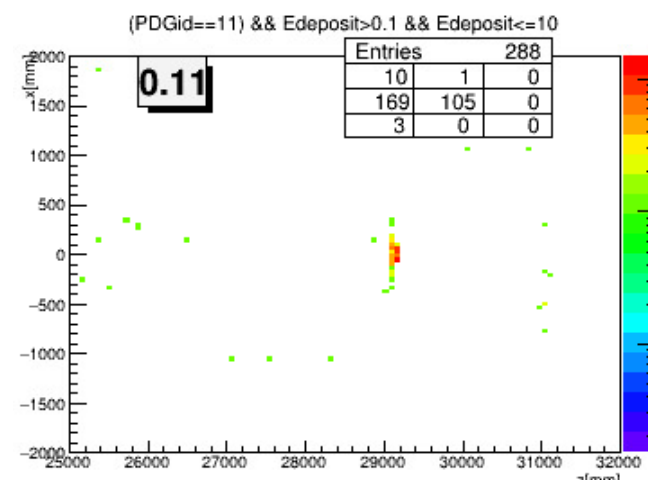
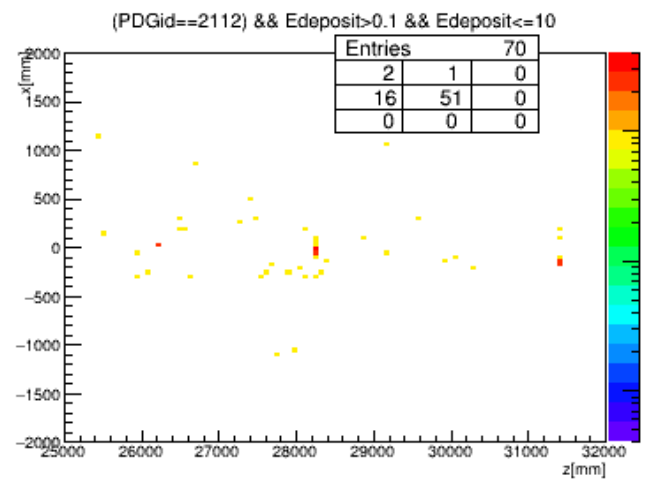
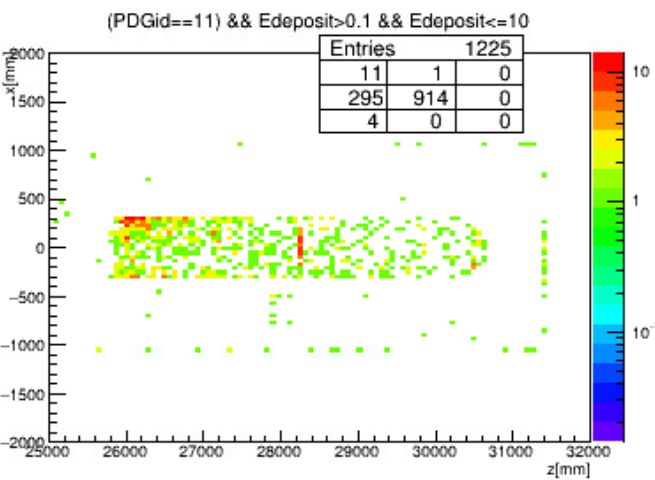
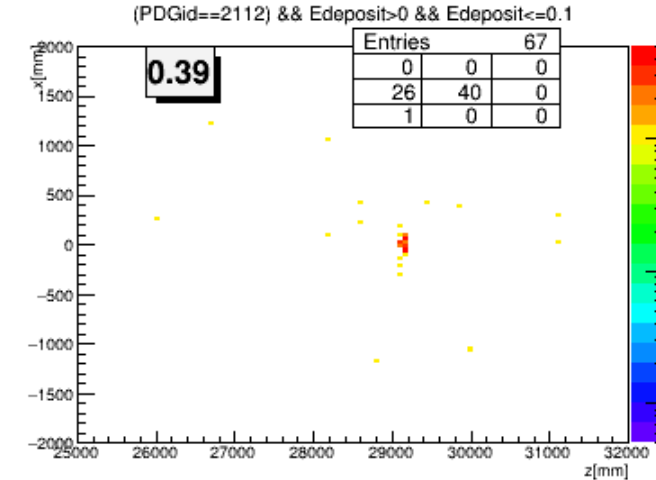
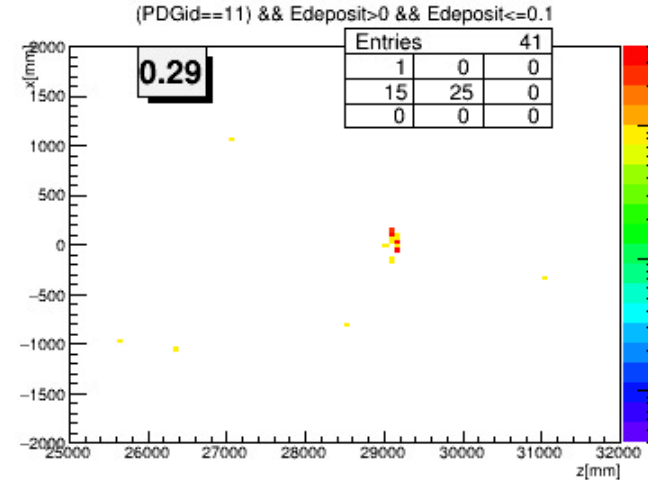
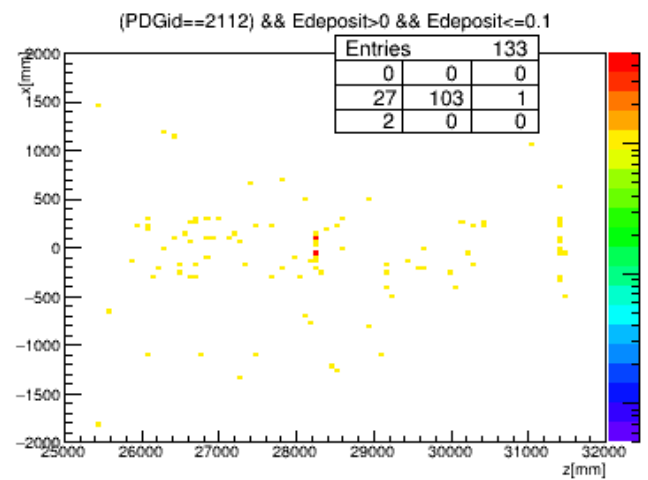
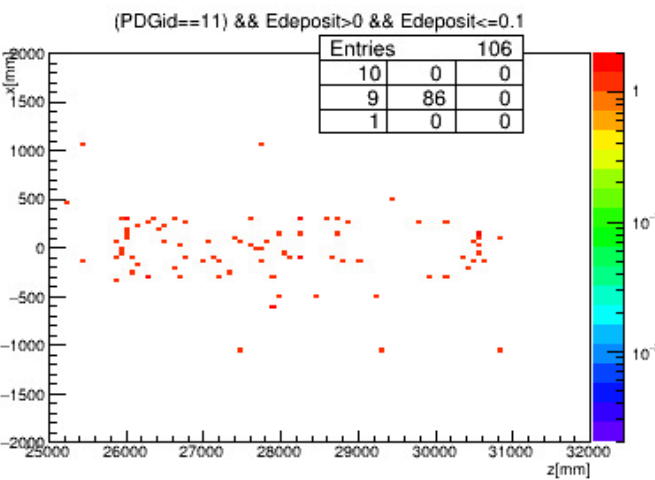
## current setup



## current setup + 4 in Donut

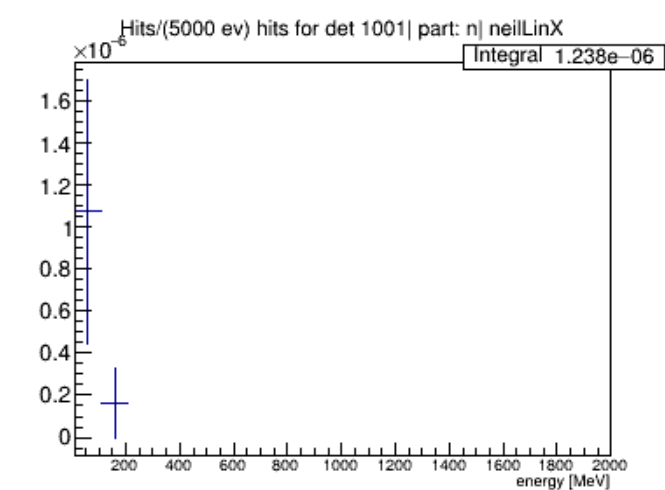
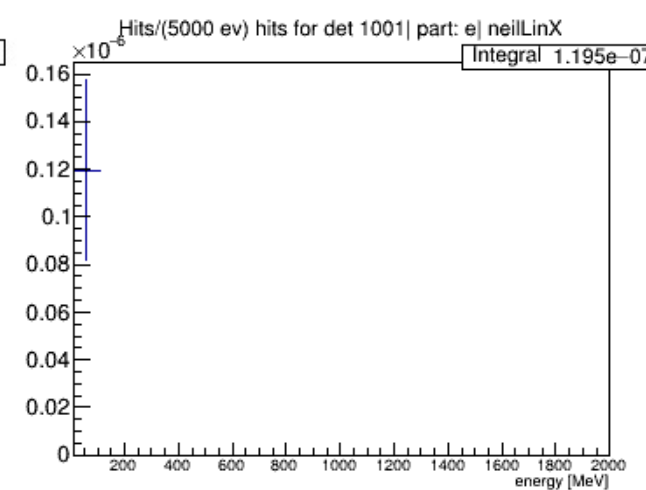
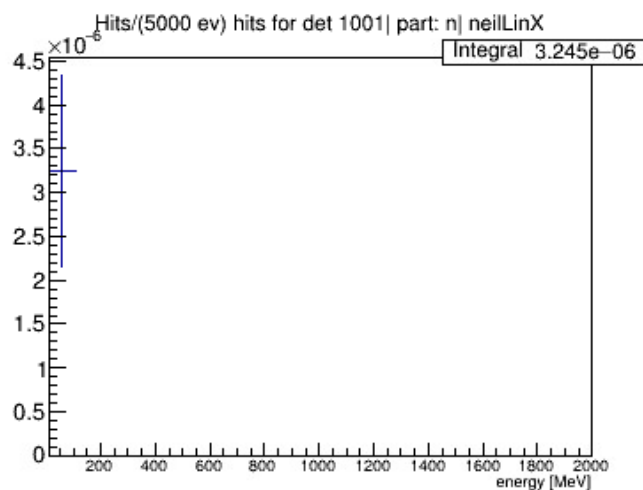
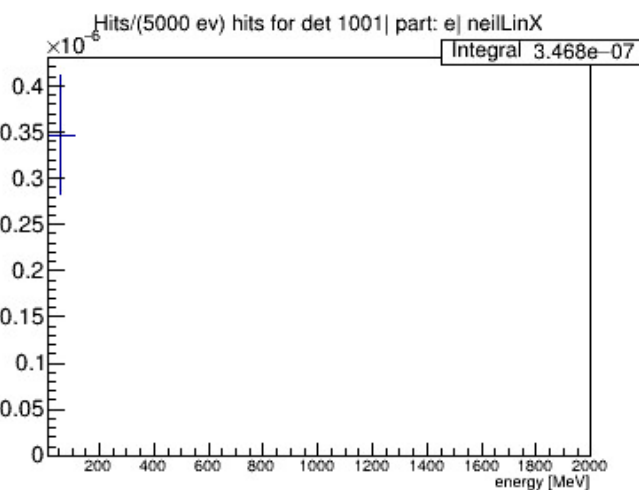
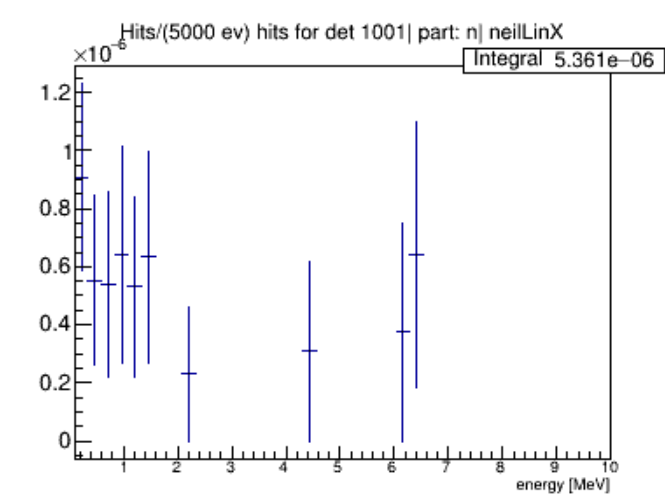
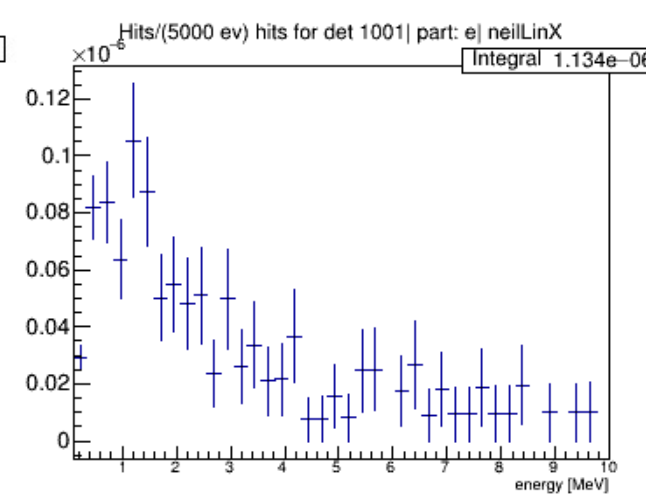
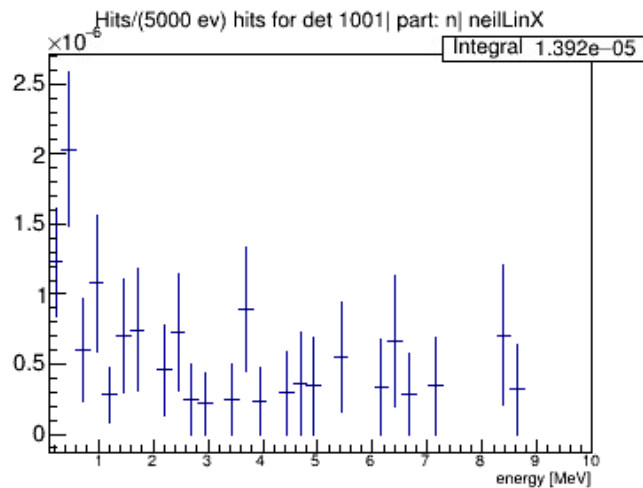
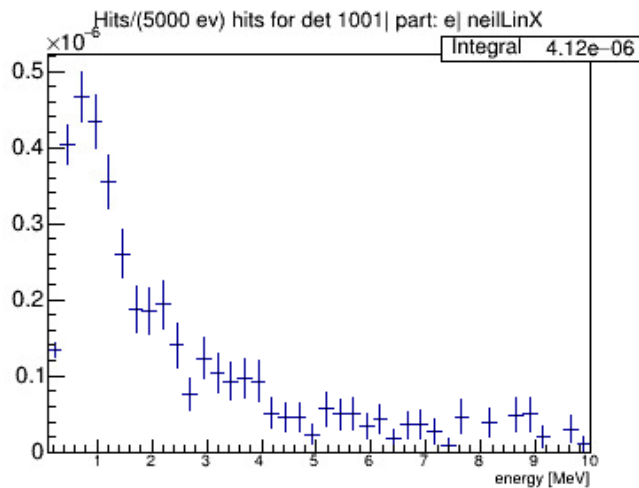
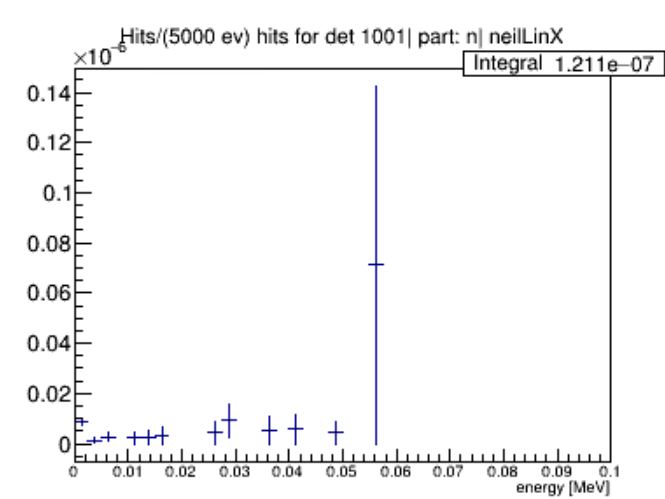
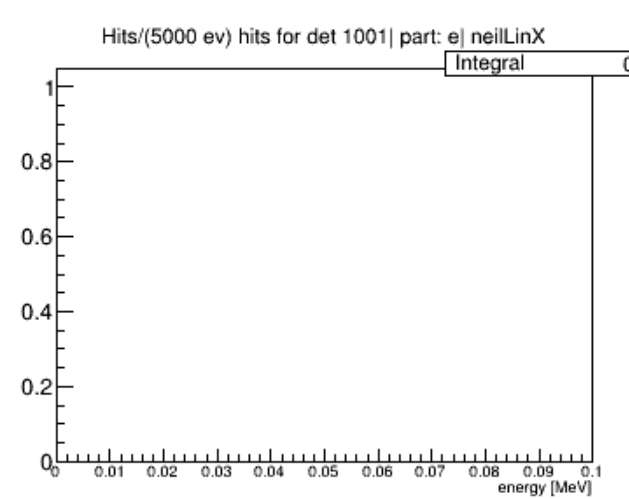
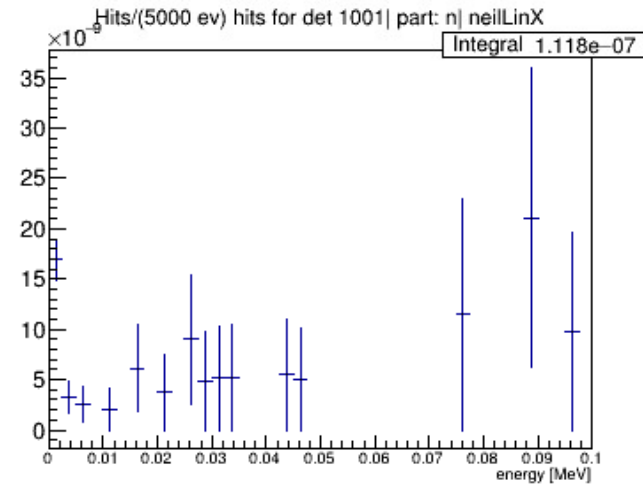
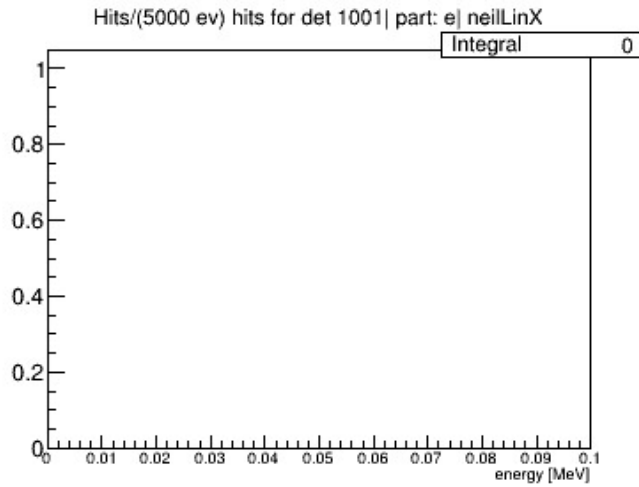
# PREX2 - comparison

## current setup



# PREX2 - comparison

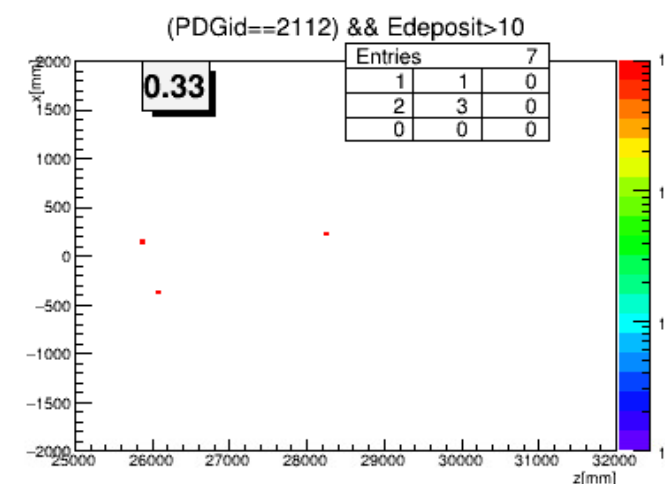
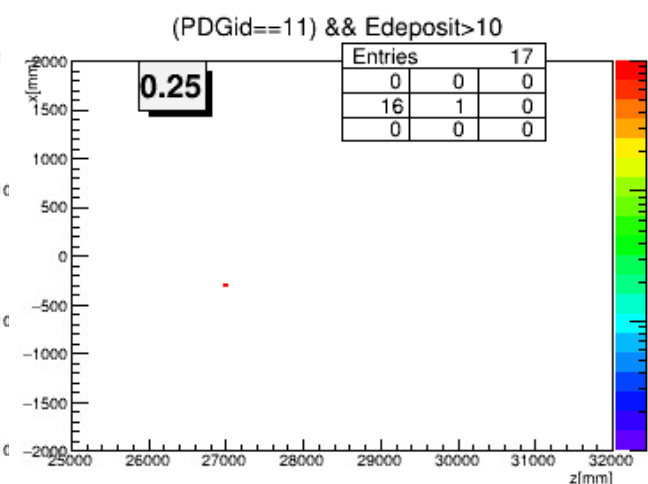
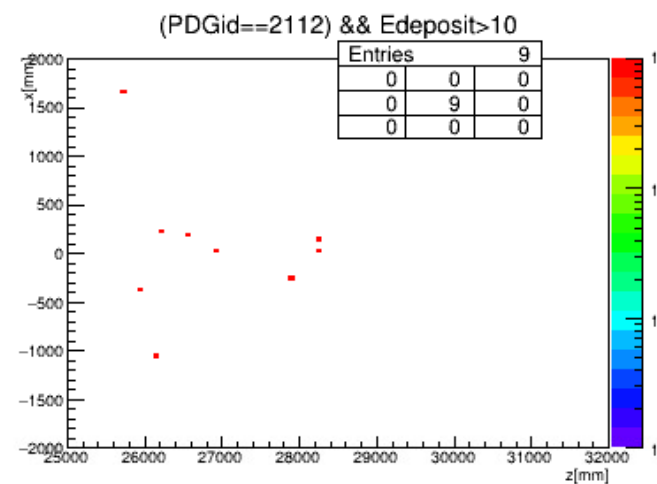
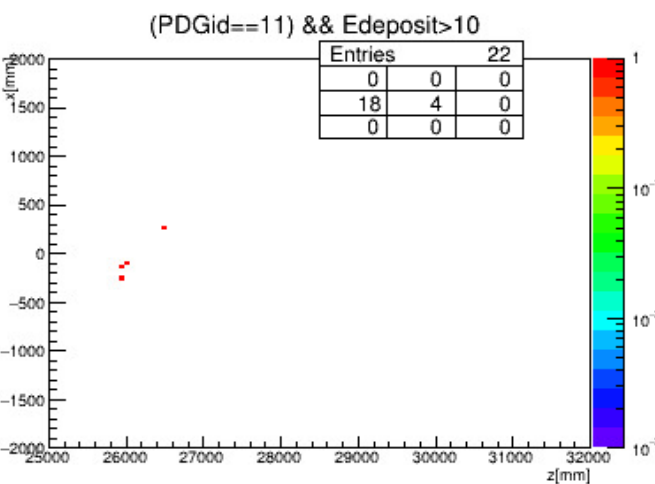
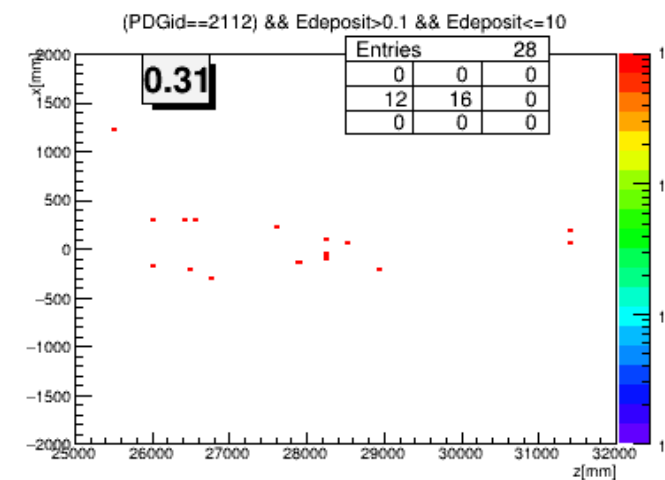
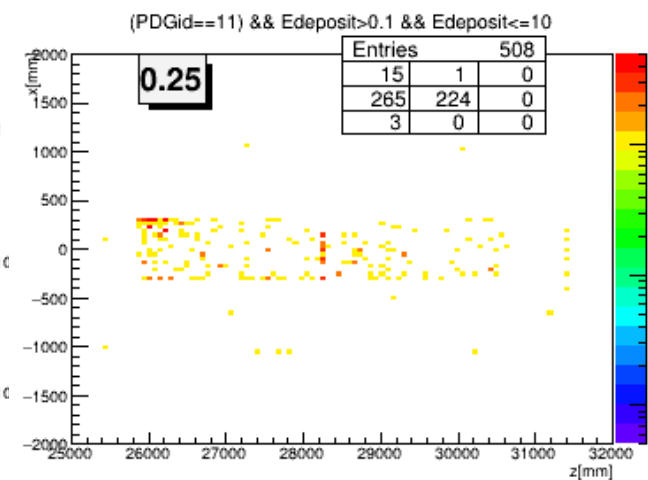
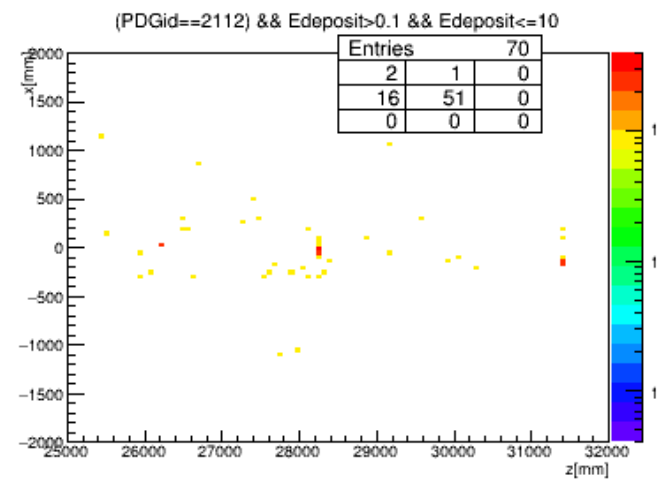
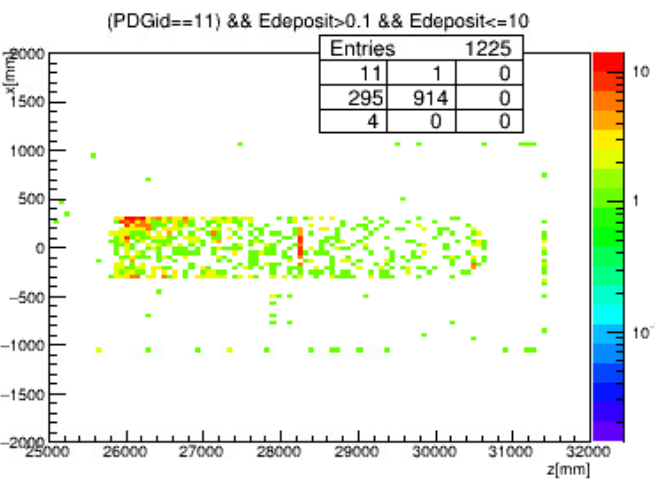
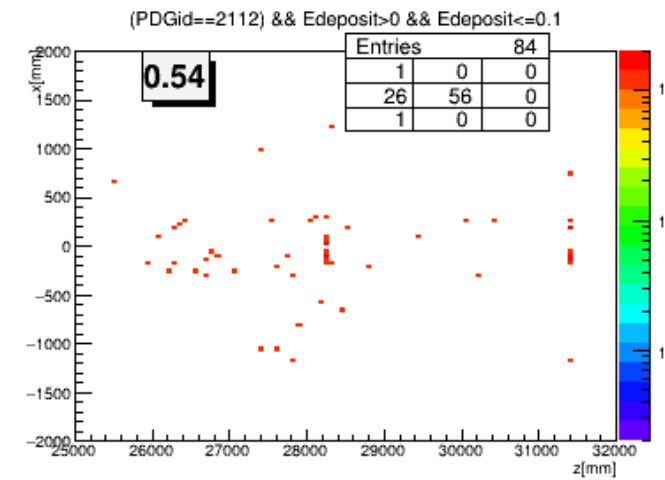
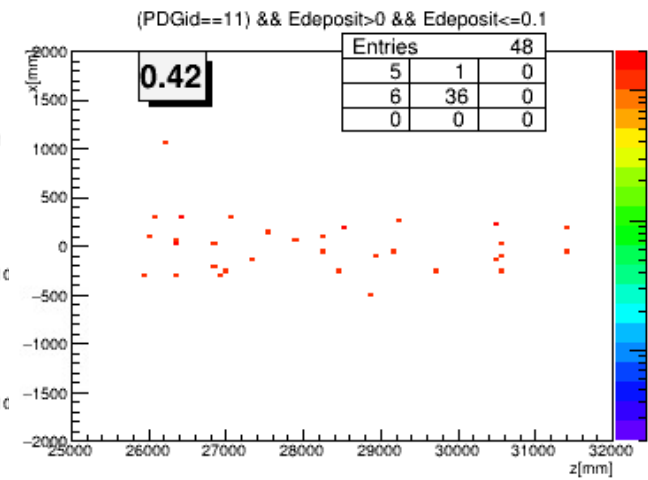
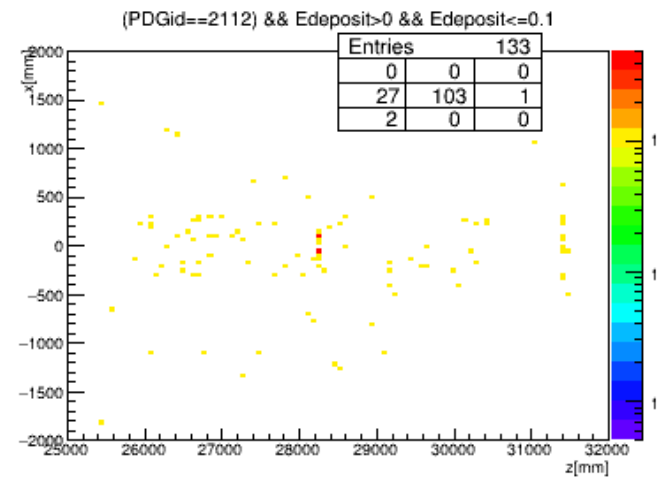
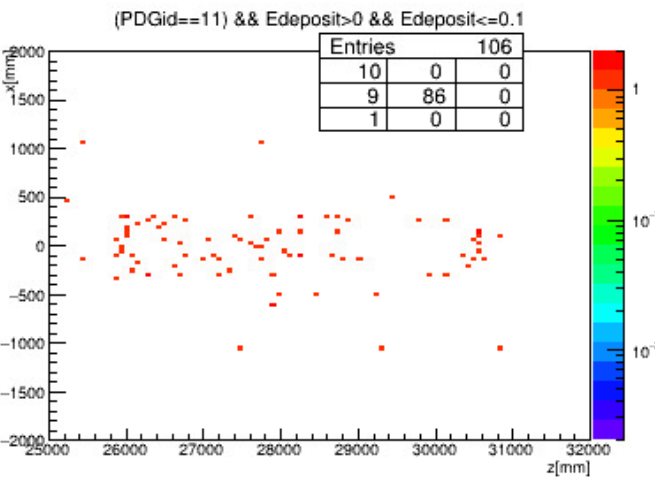
## current setup



## PREX1 dump configuration

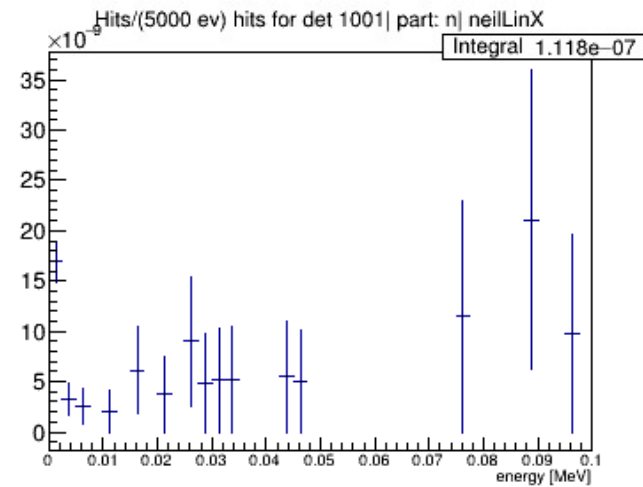
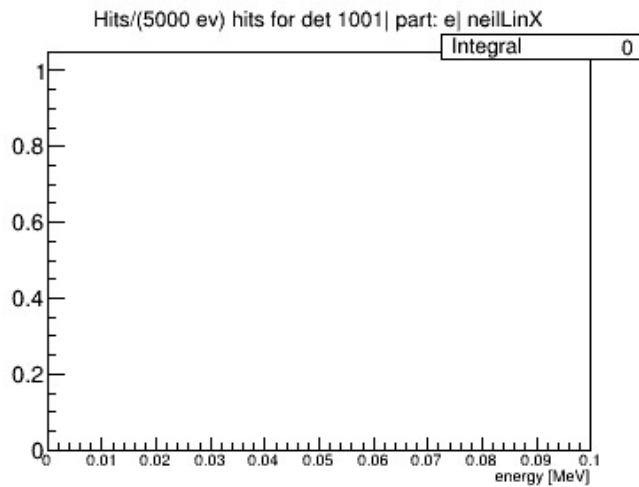
# PREX2 - comparison

## current setup

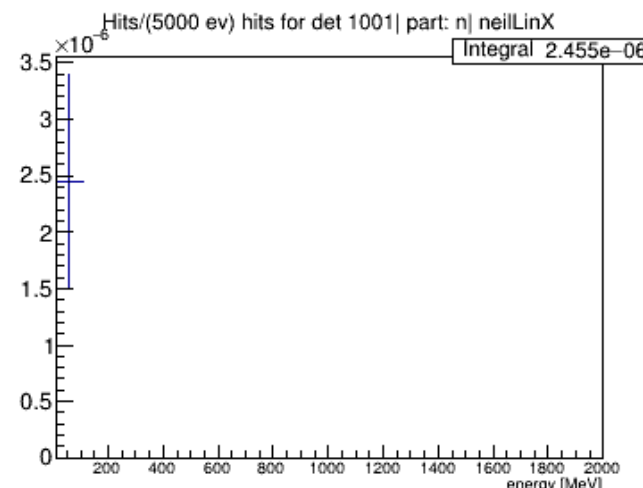
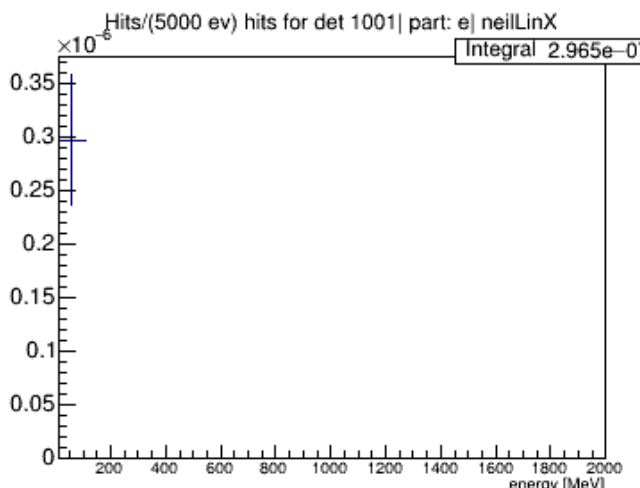
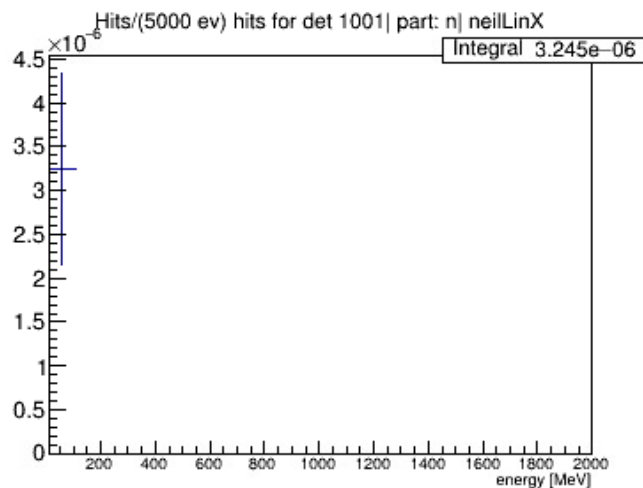
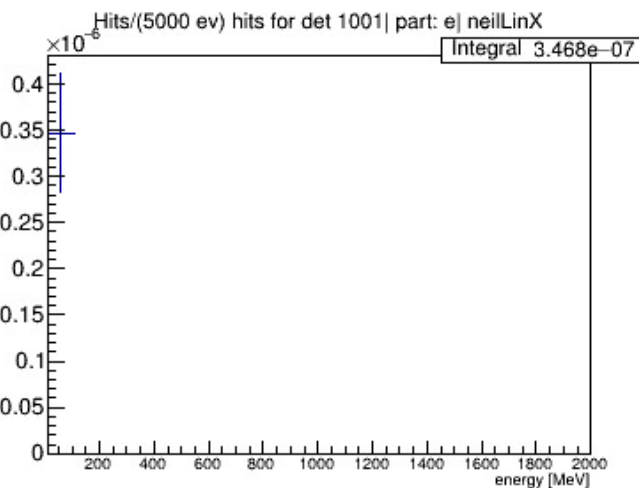
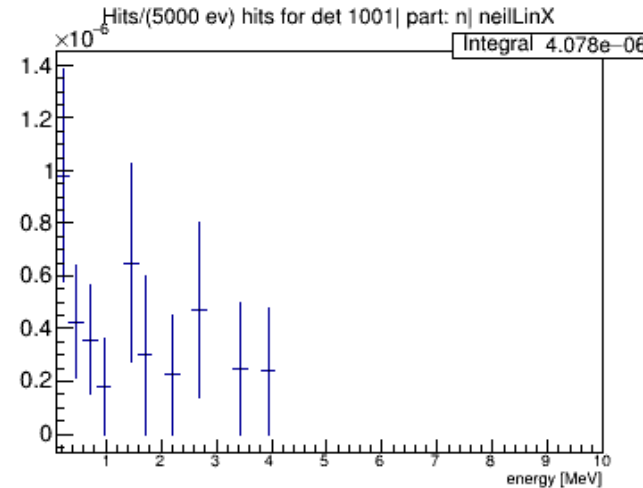
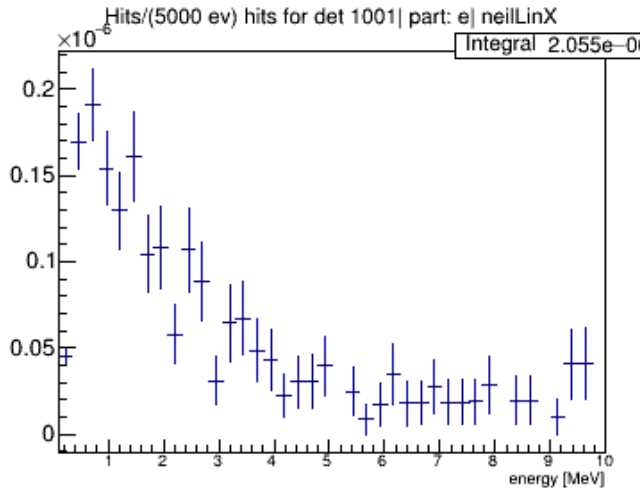
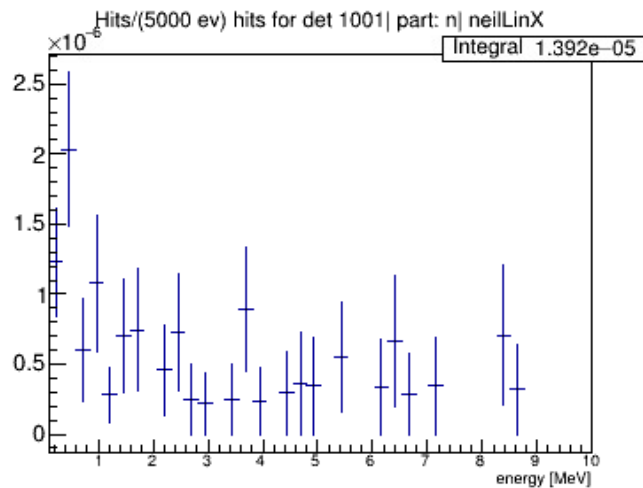
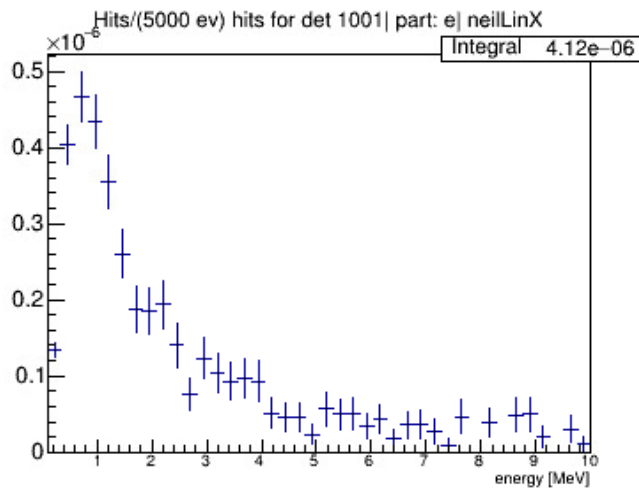
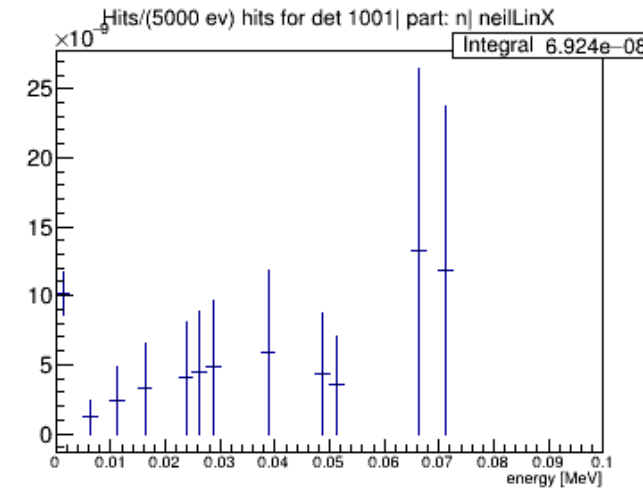
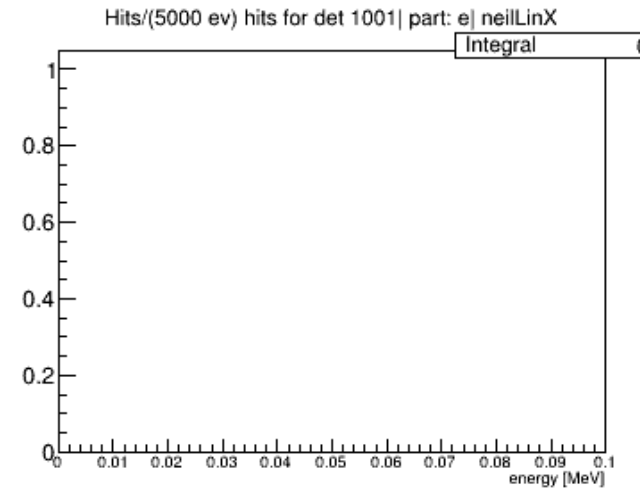


# PREX2 - comparison

## current setup



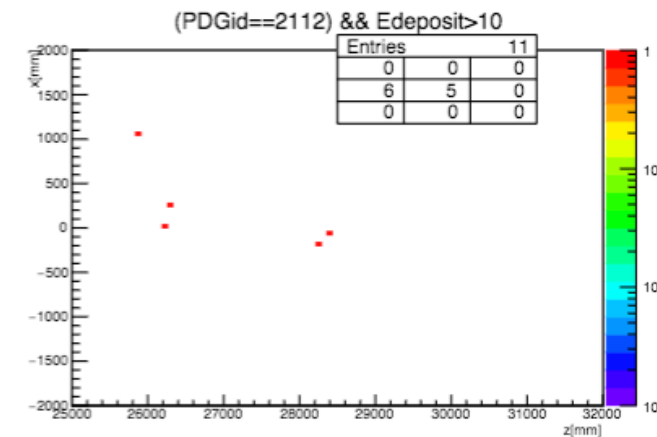
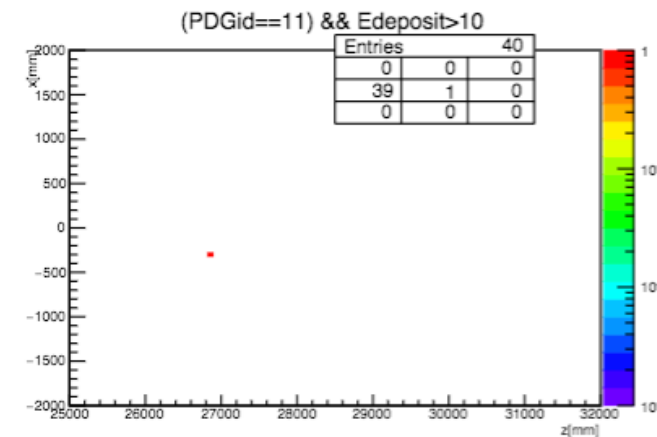
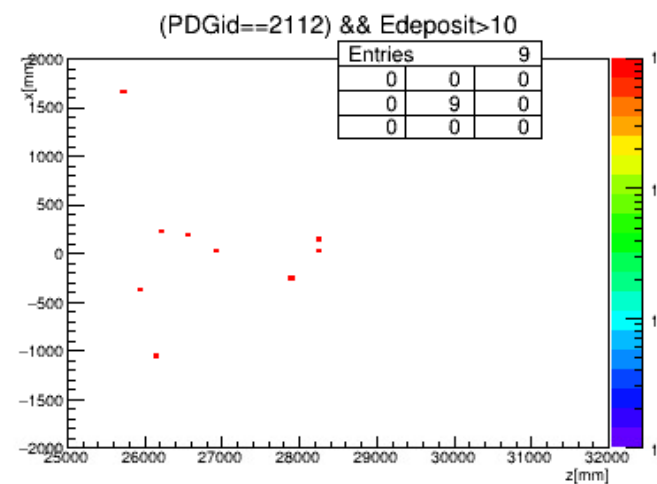
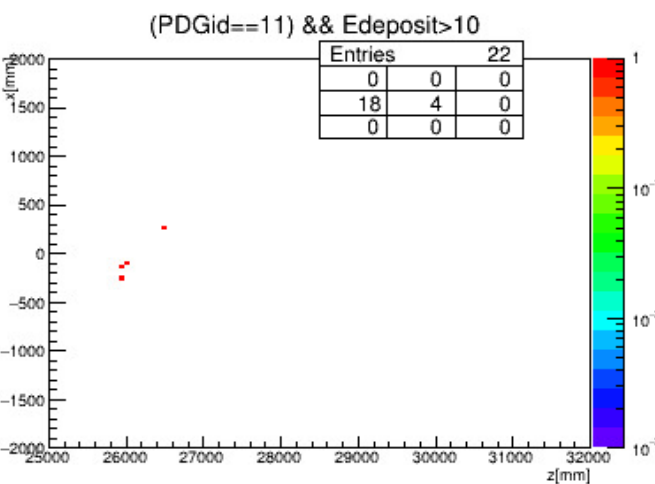
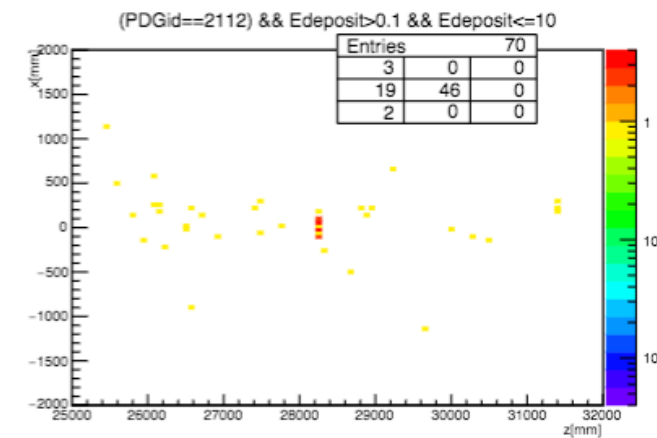
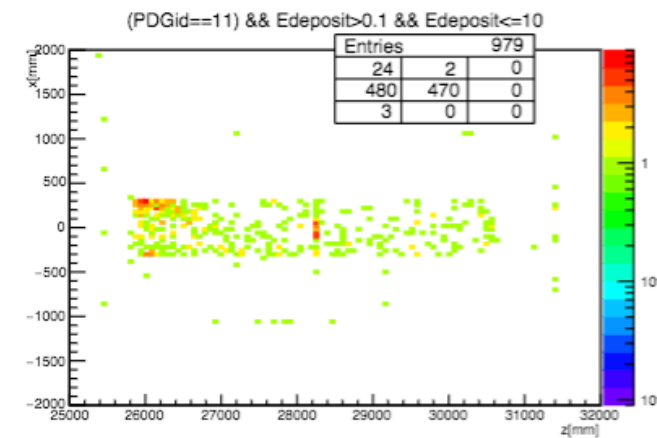
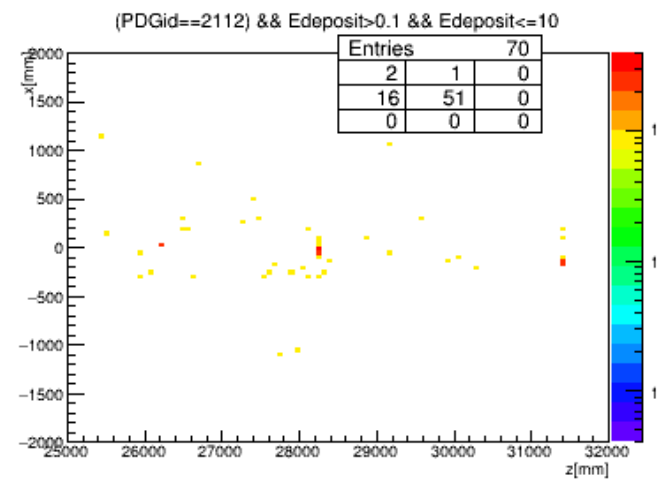
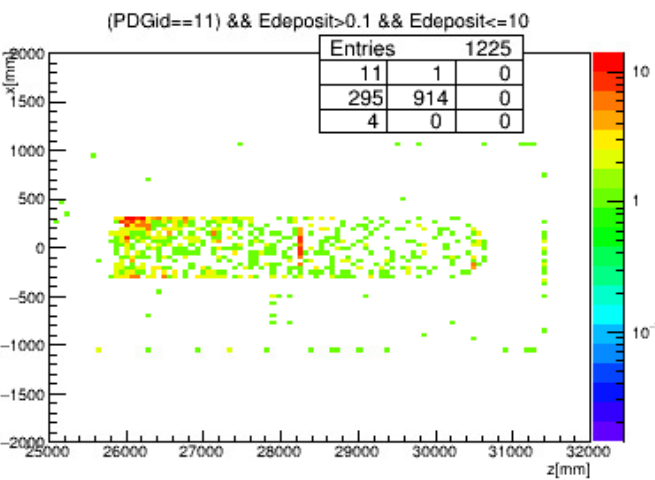
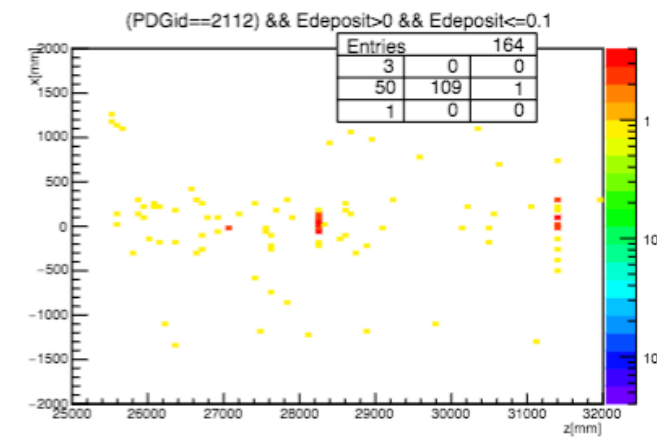
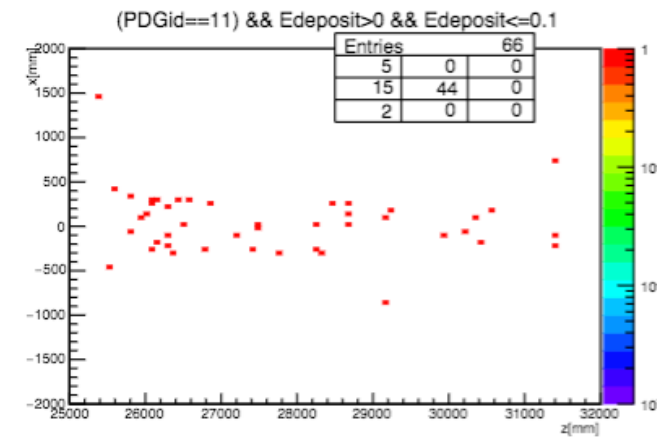
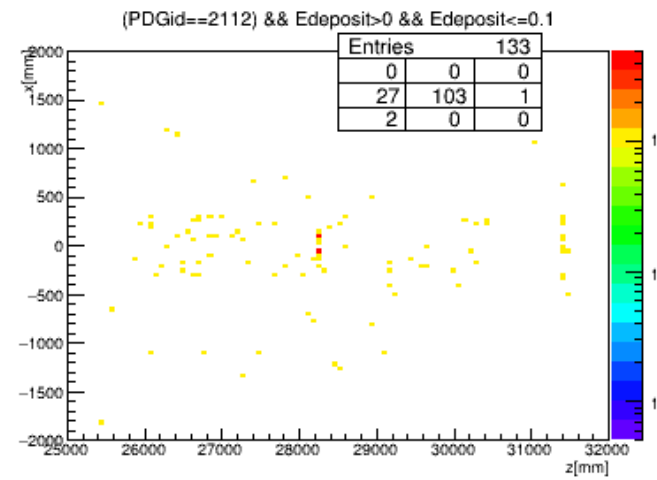
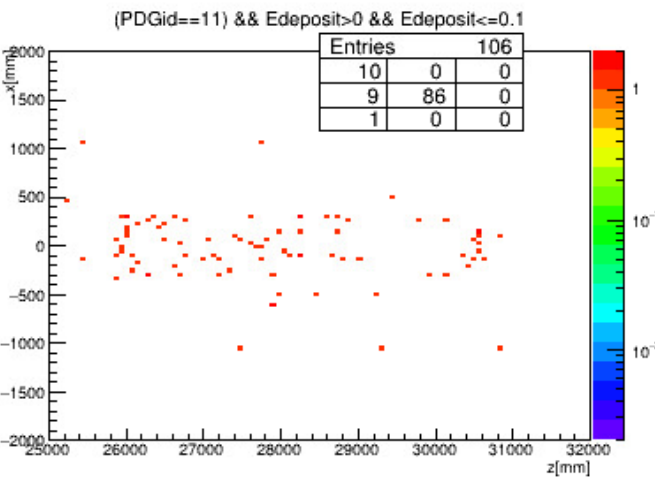
## current setup + 1 ft concrete shield





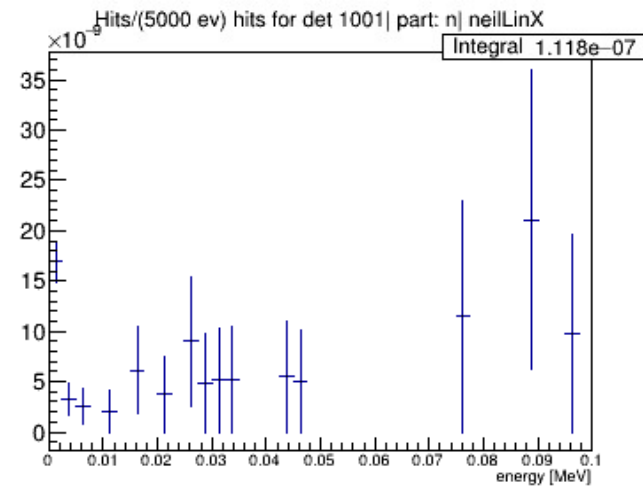
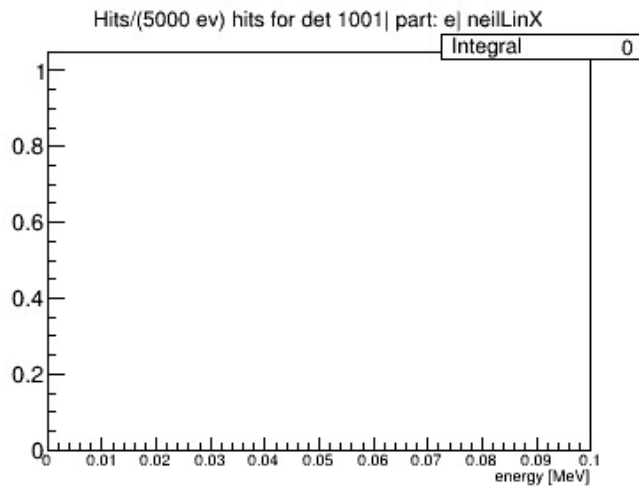
# PREX2 - comparison

## current setup

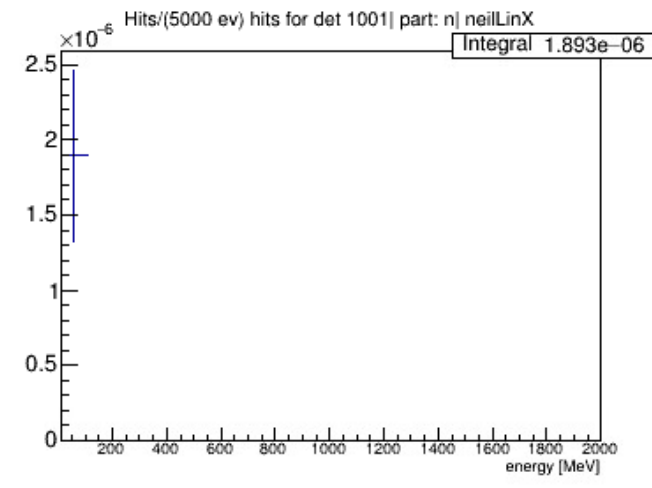
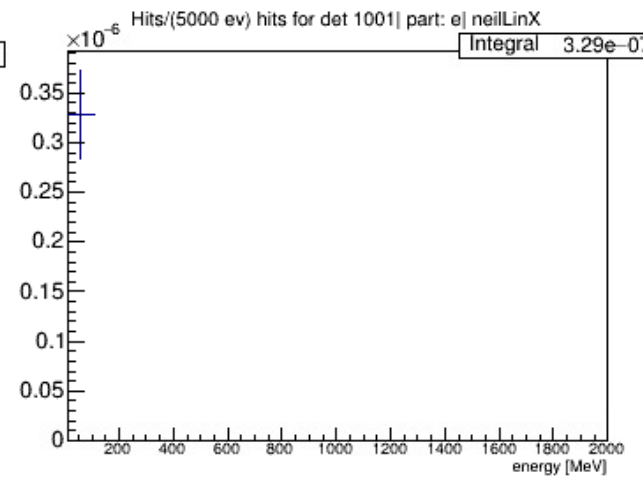
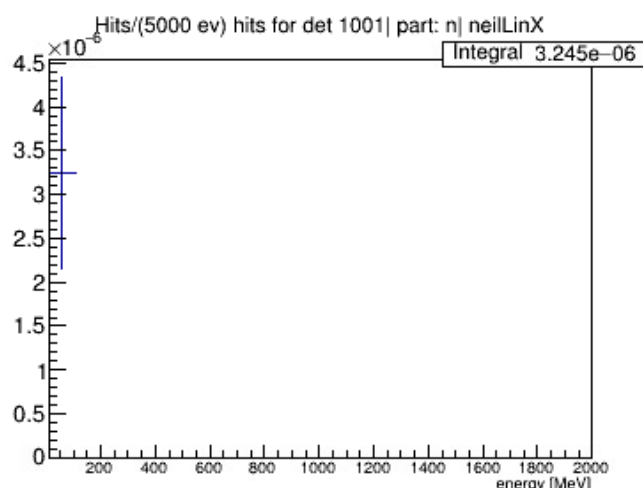
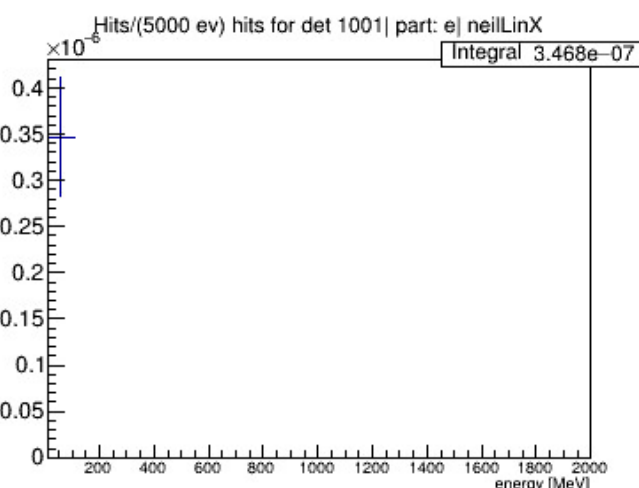
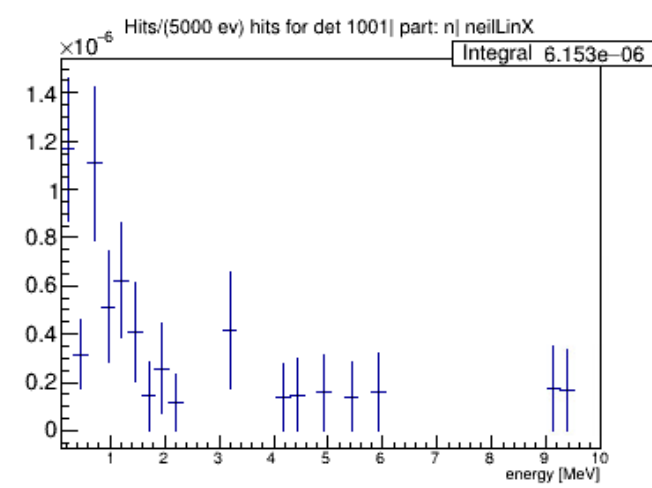
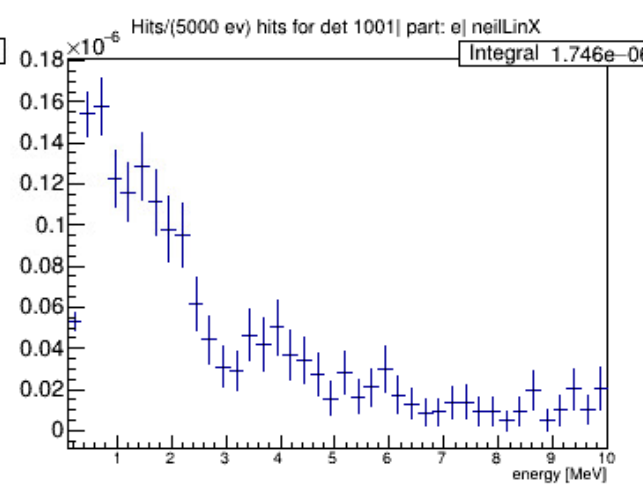
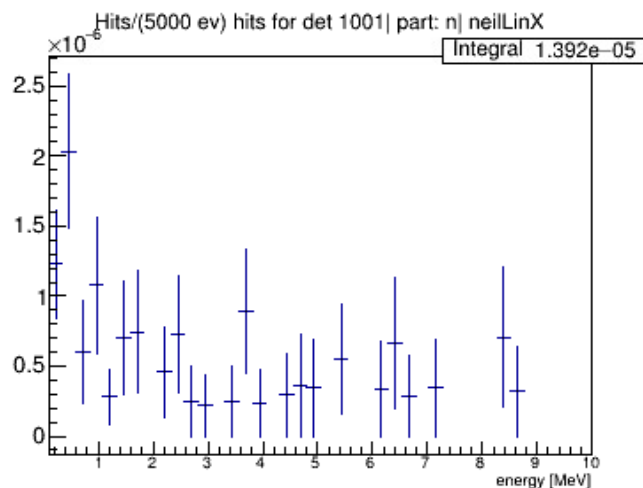
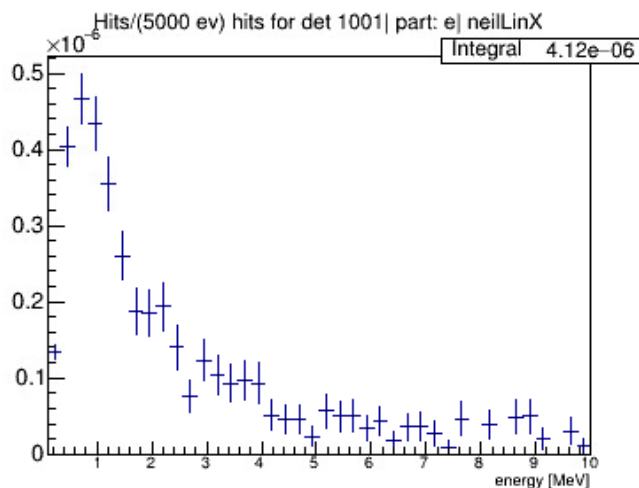
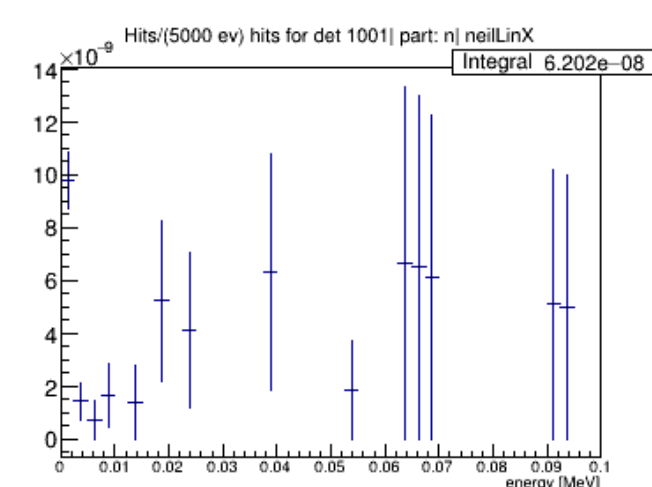
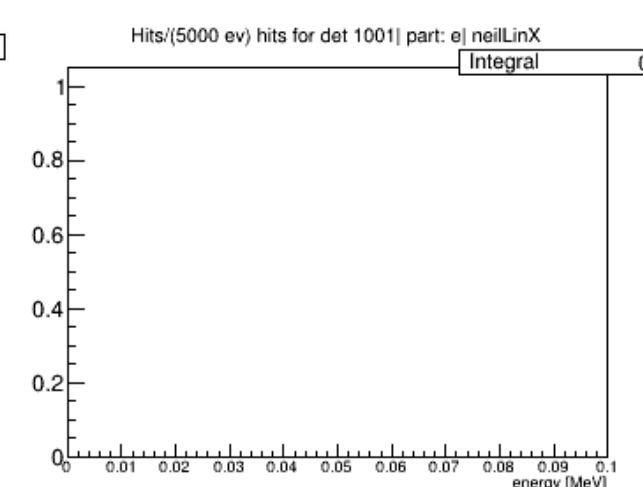


# PREX2 - comparison

## current setup

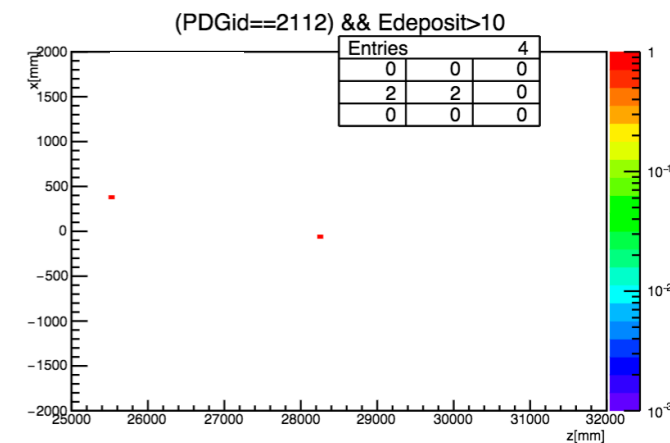
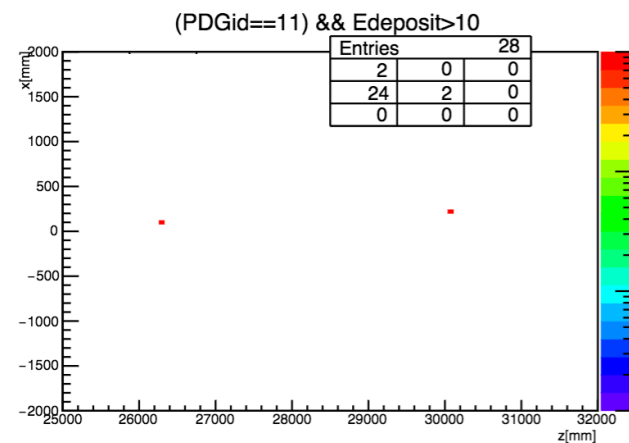
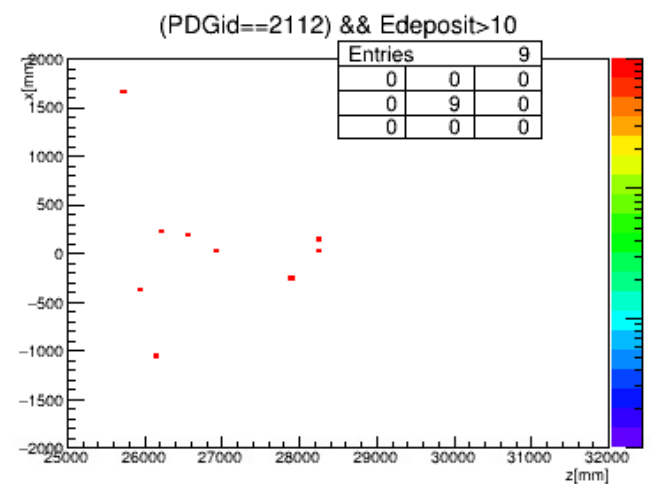
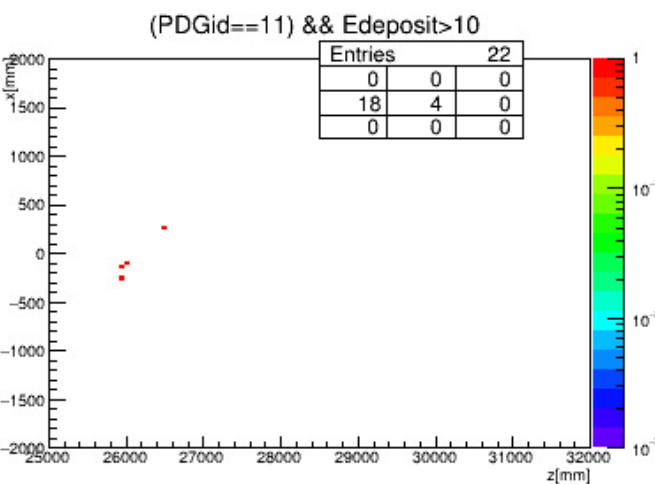
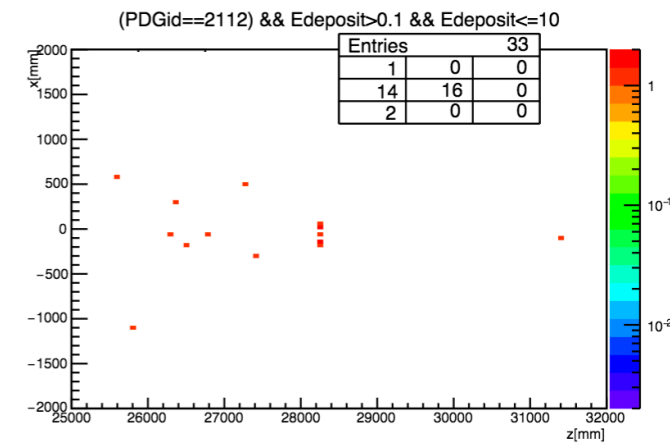
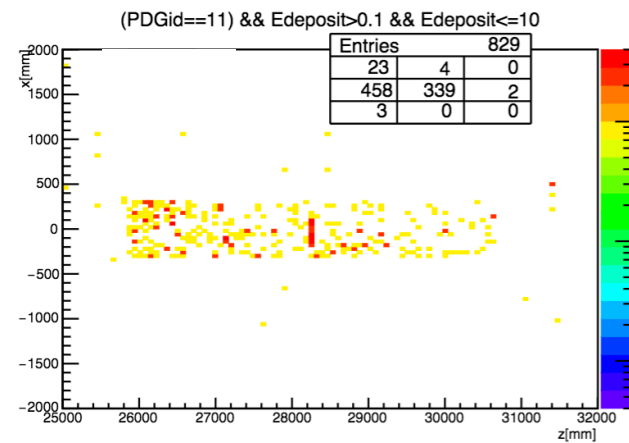
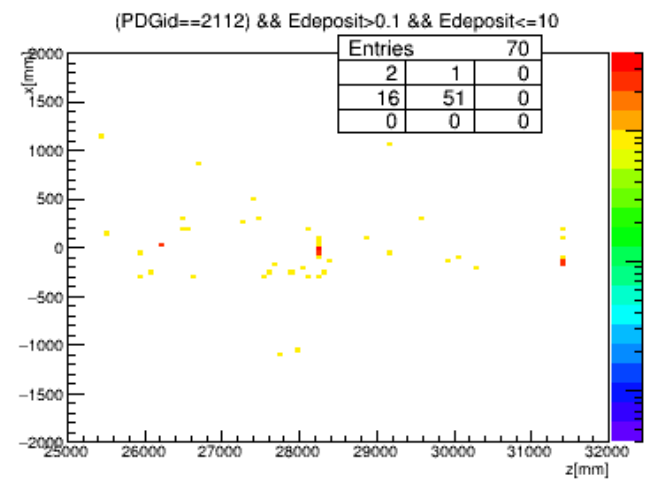
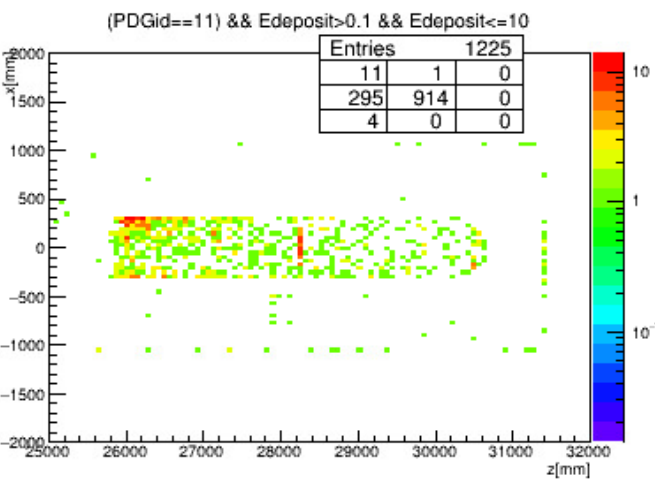
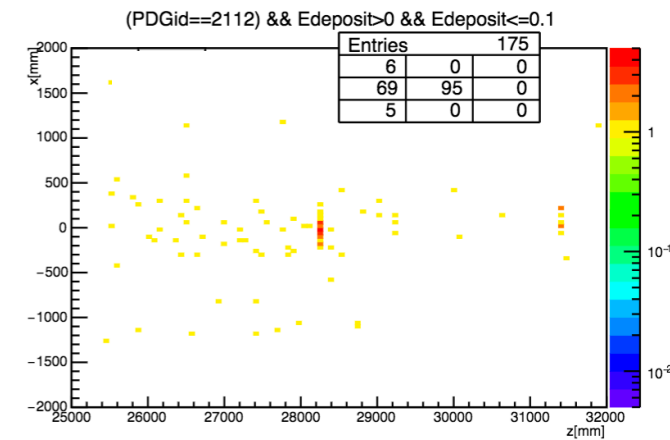
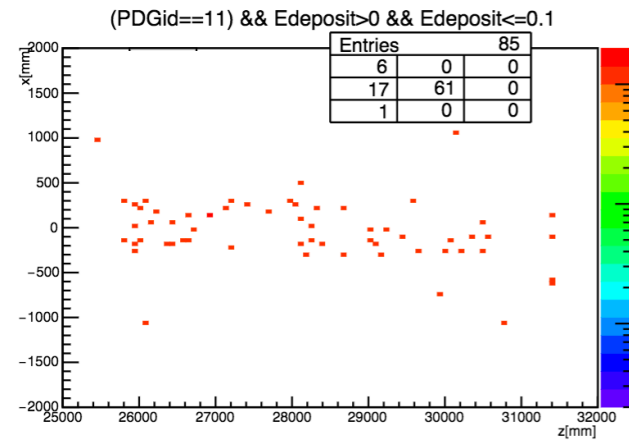
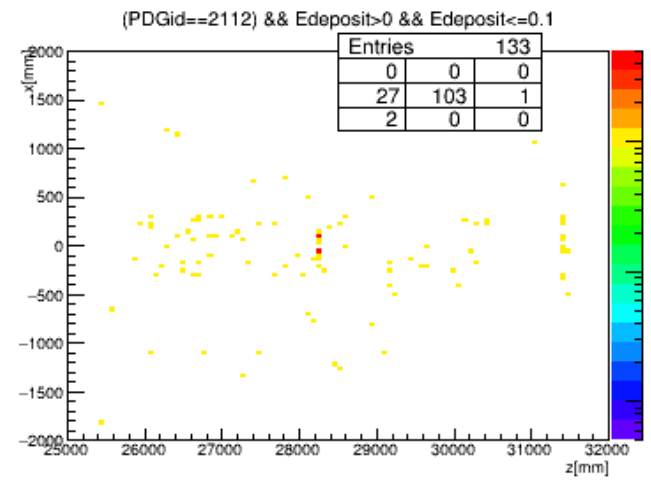
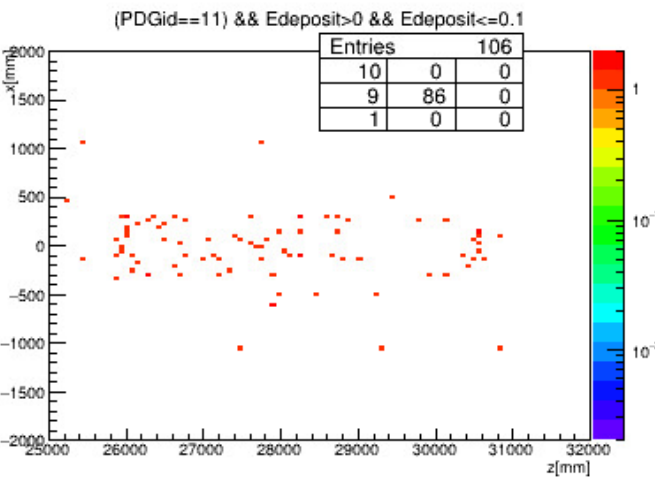


## current setup + 0.5 ft concrete shield



# PREX2 - comparison

## current setup

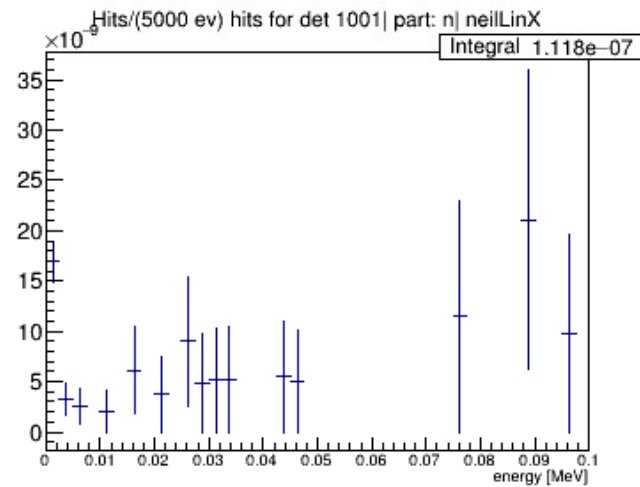
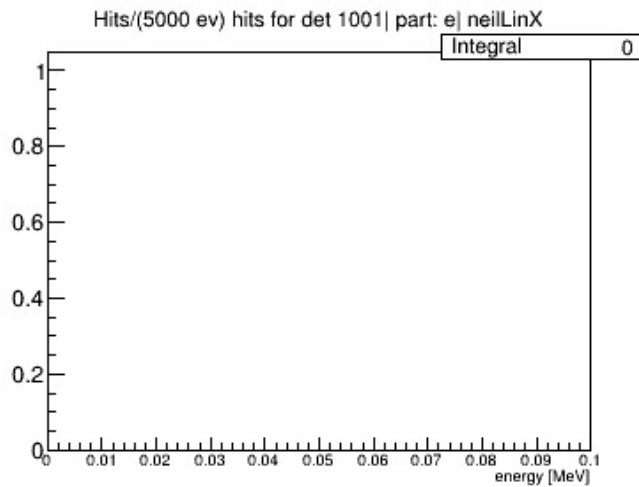


## current setup + 2 ft concrete shield (2x stat)

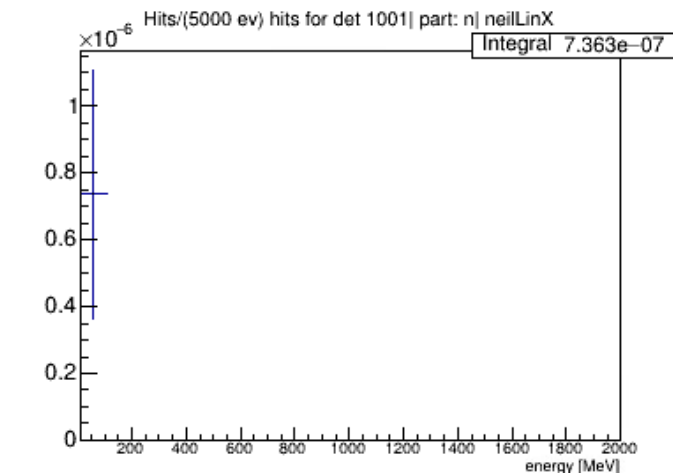
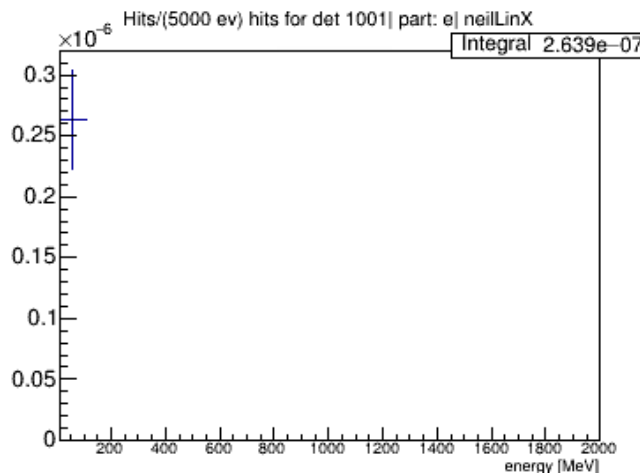
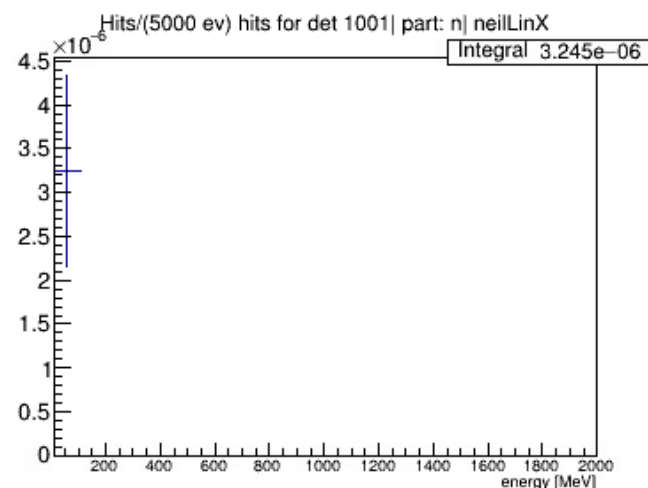
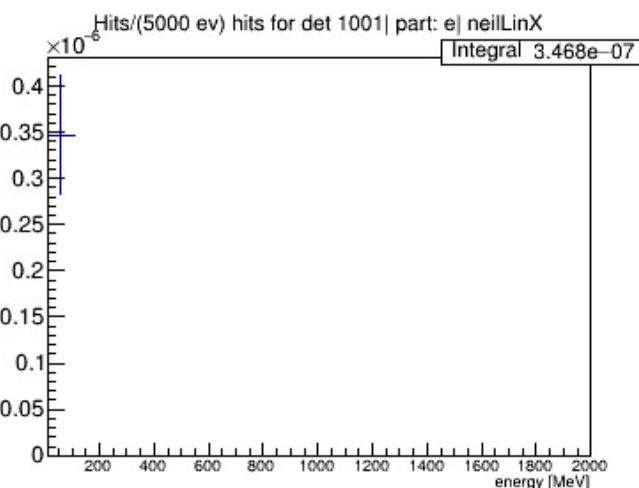
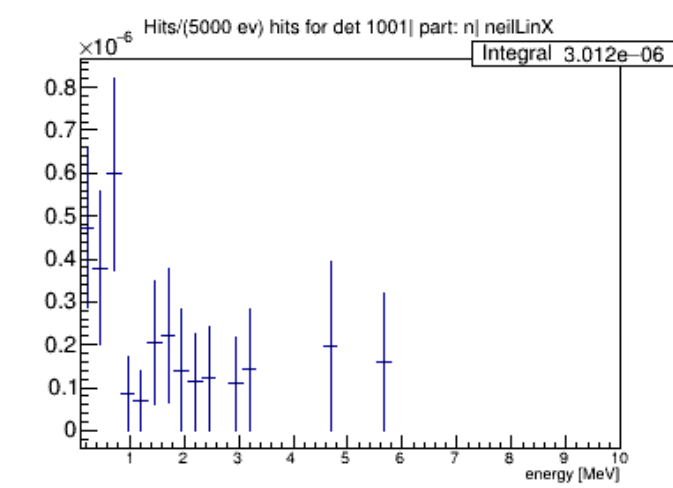
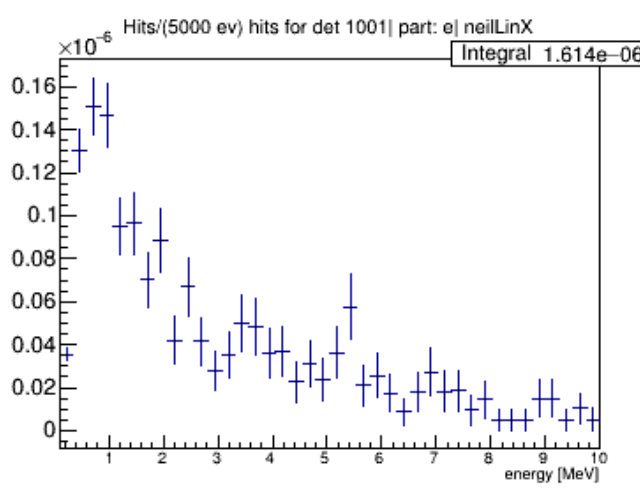
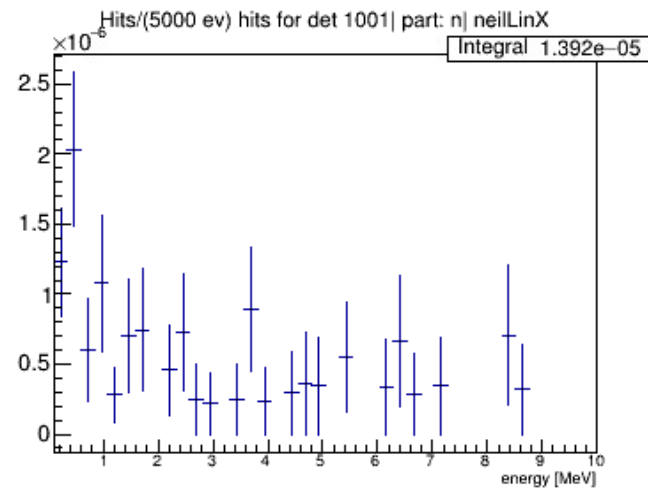
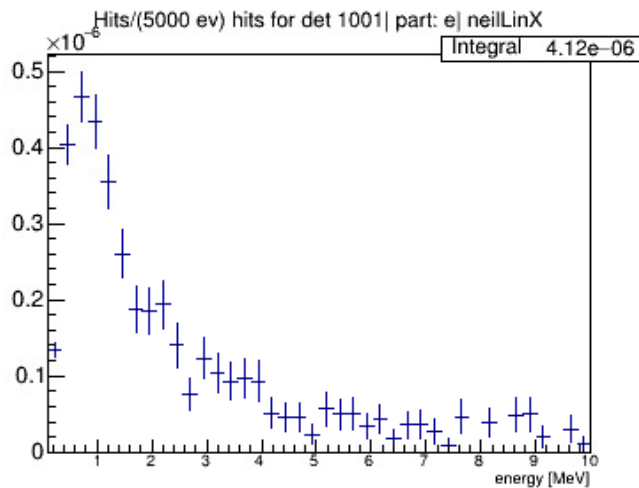
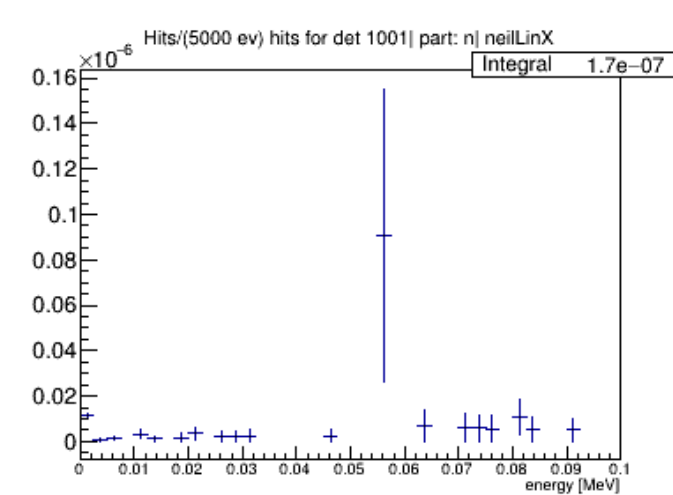
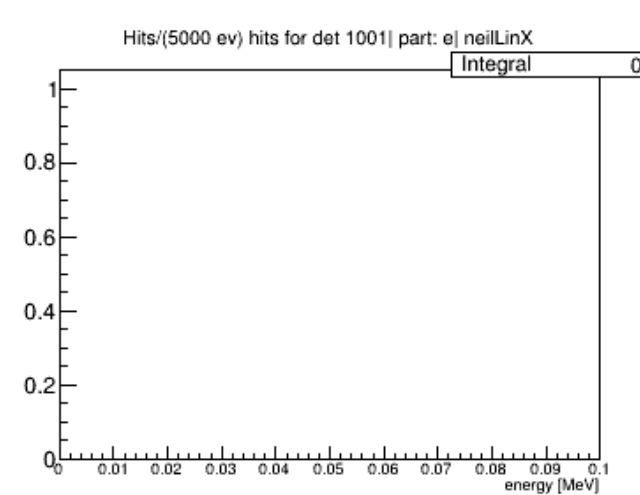


# PREX2 - comparison

## current setup

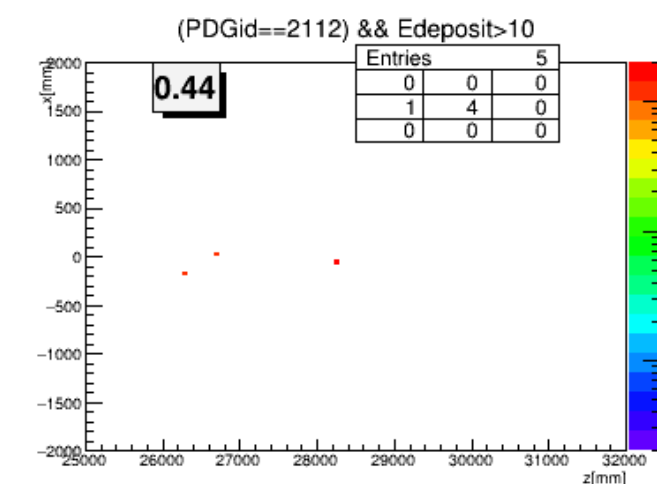
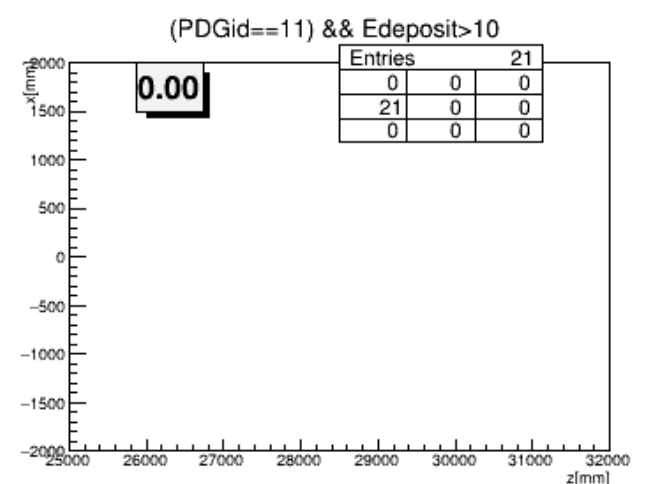
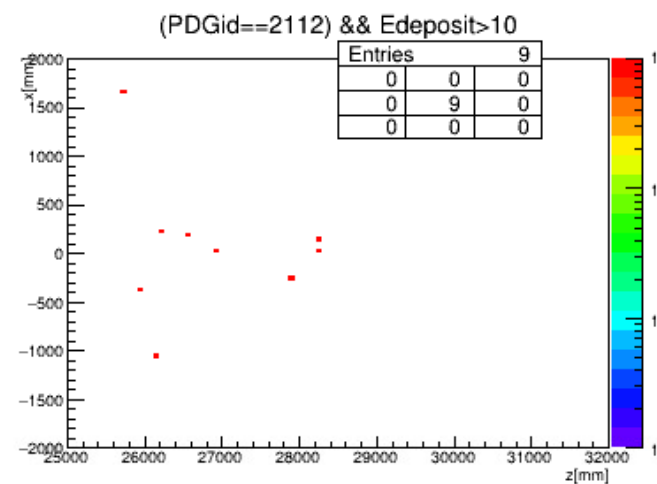
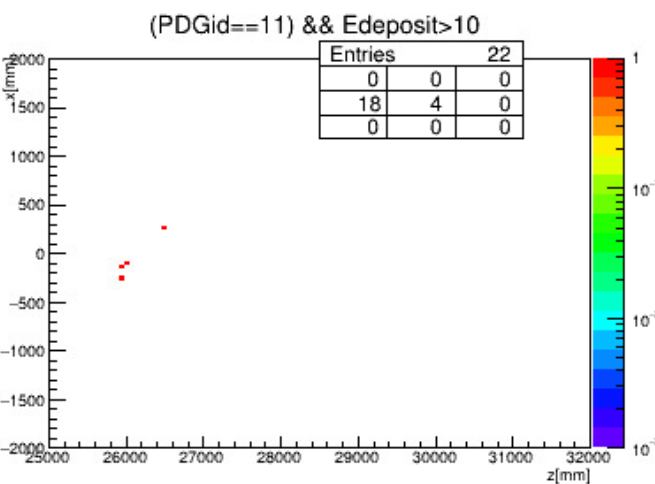
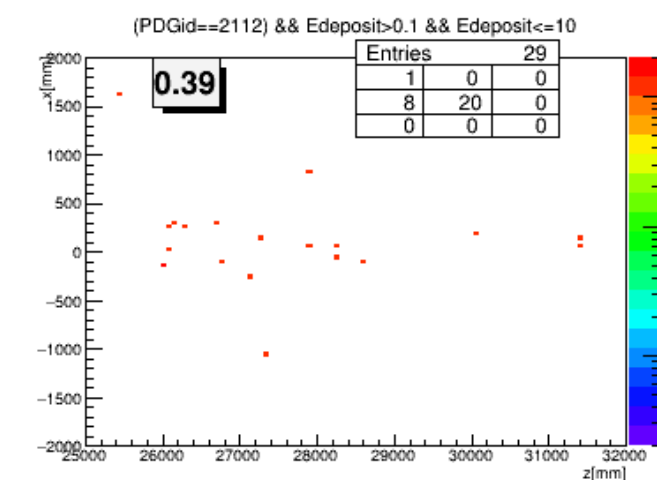
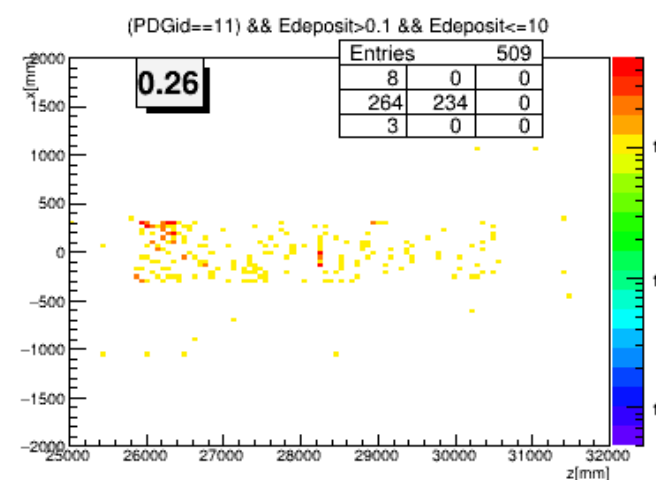
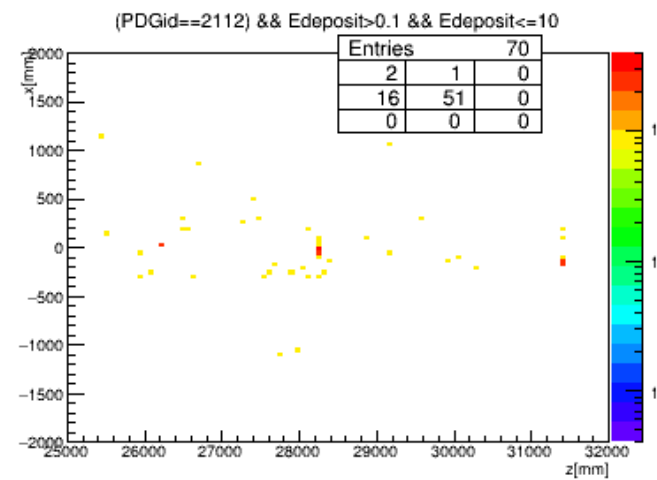
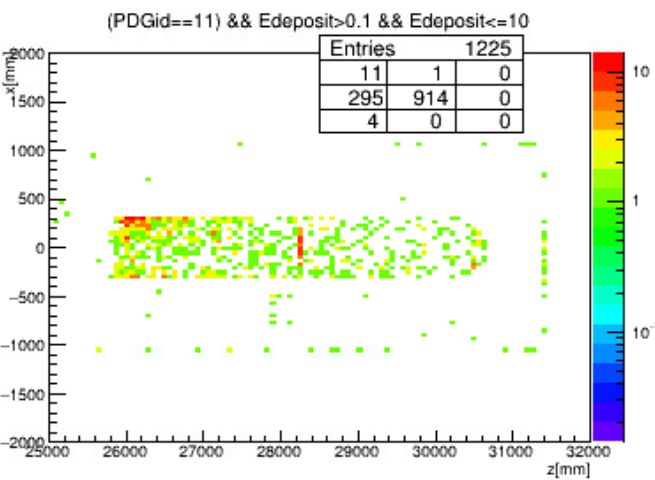
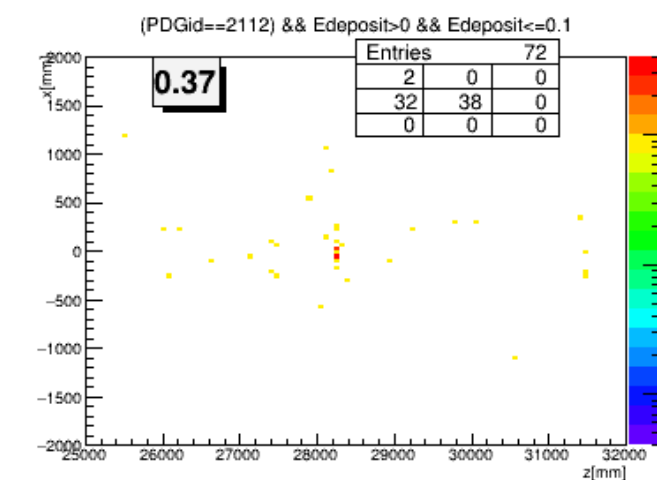
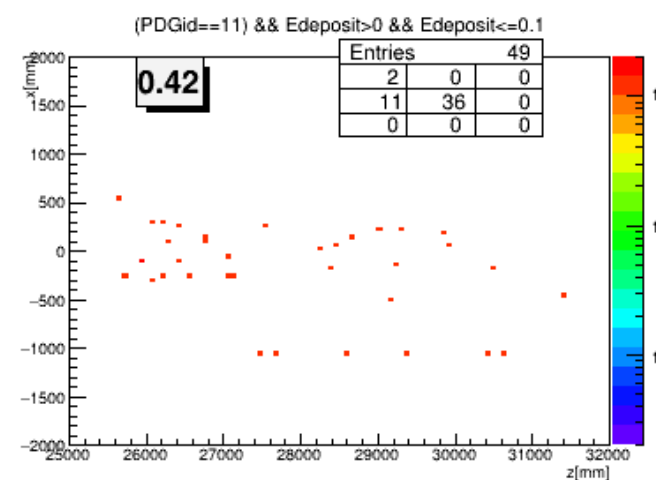
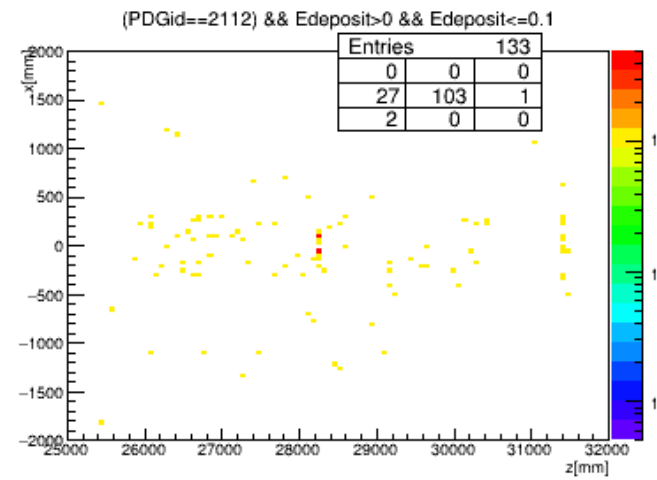
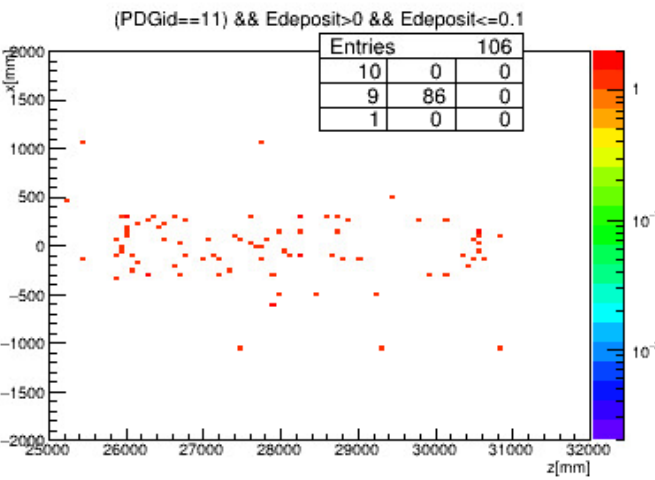


## current setup + 2 ft concrete shield



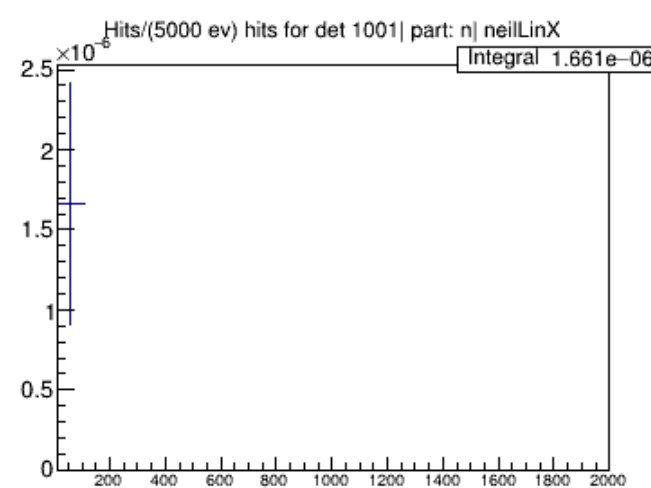
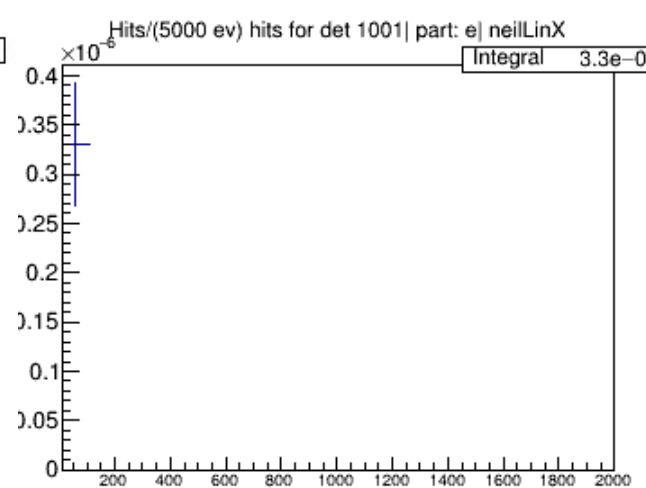
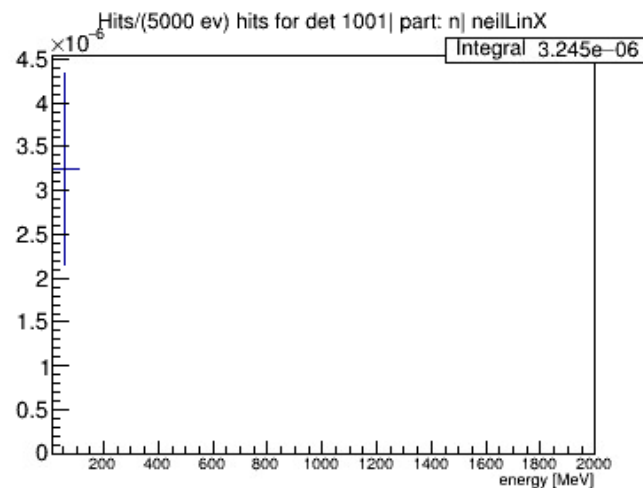
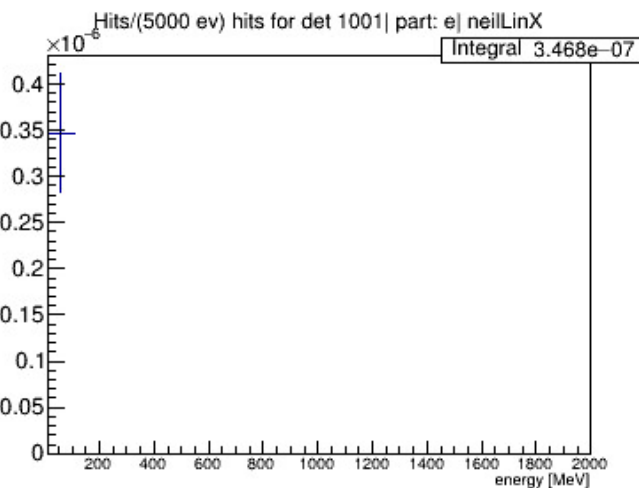
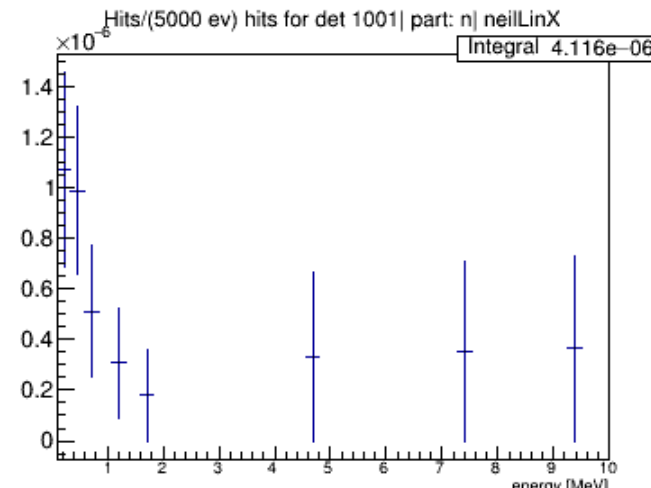
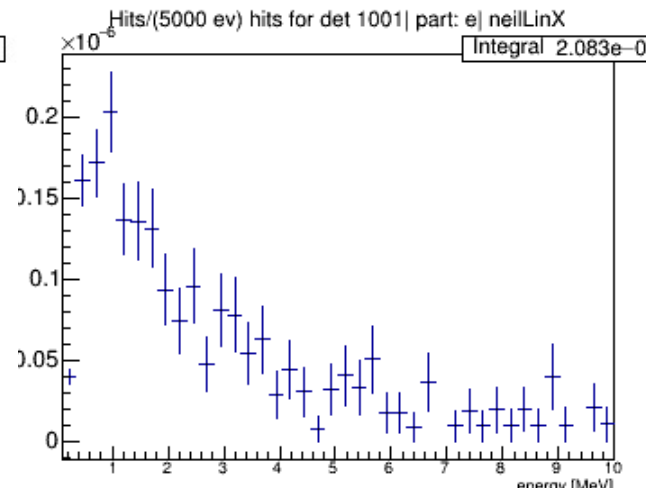
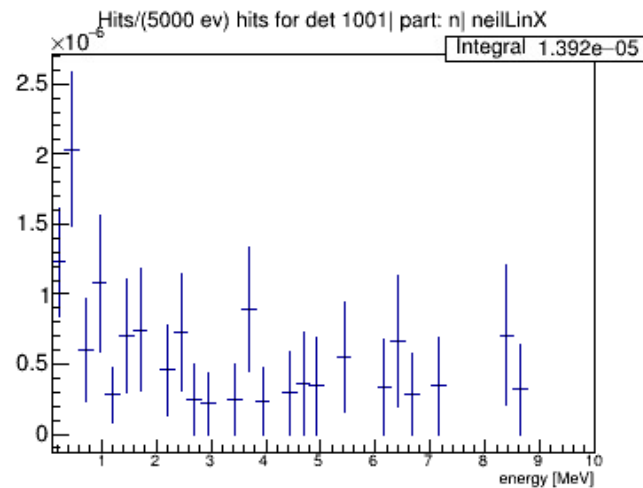
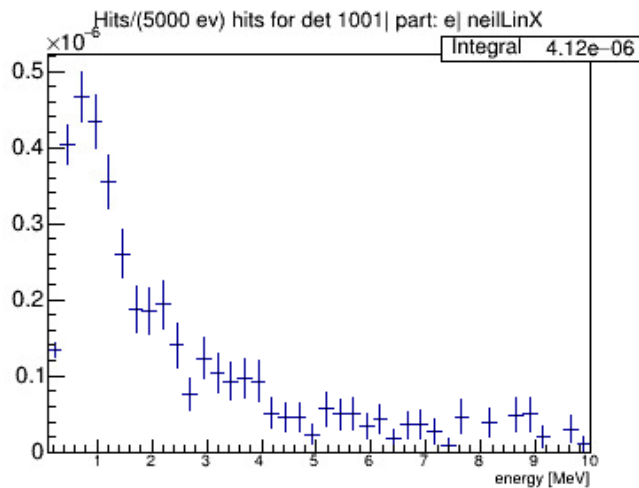
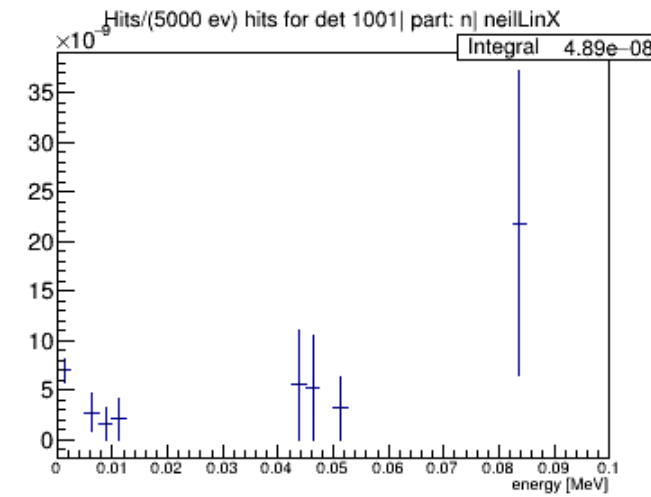
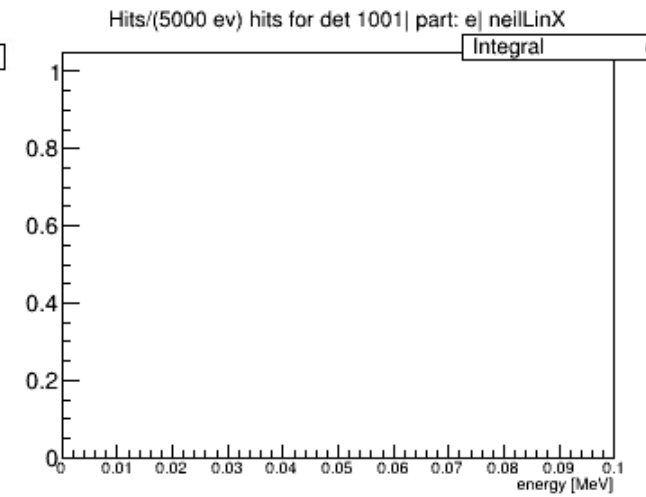
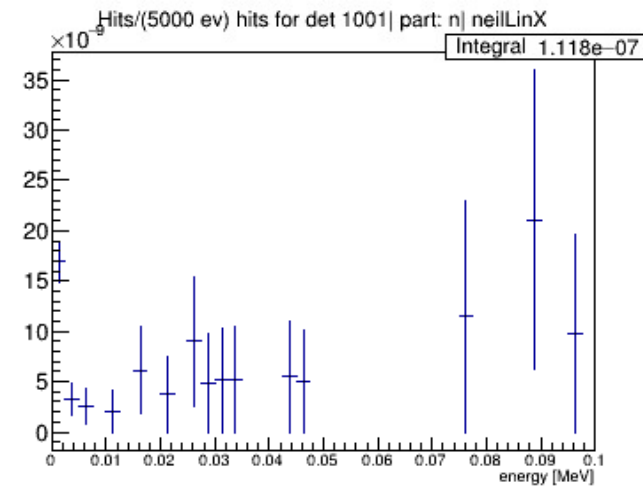
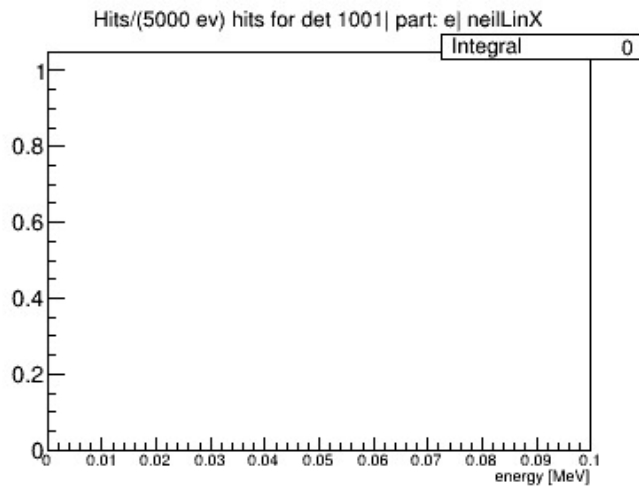
# PREX2 - comparison

## current setup



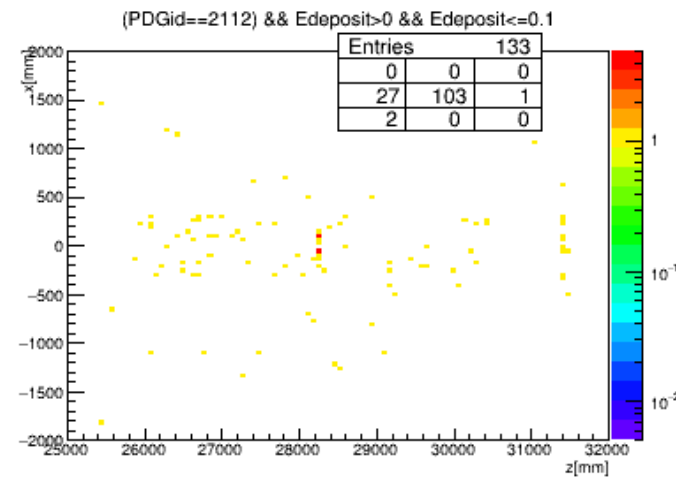
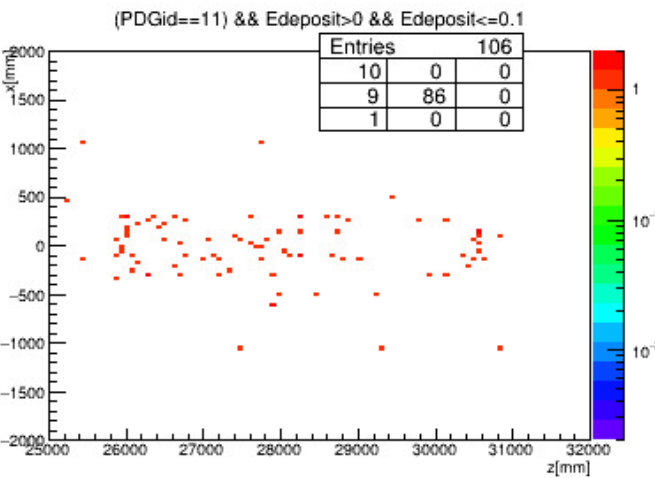
# PREX2 - comparison

## current setup

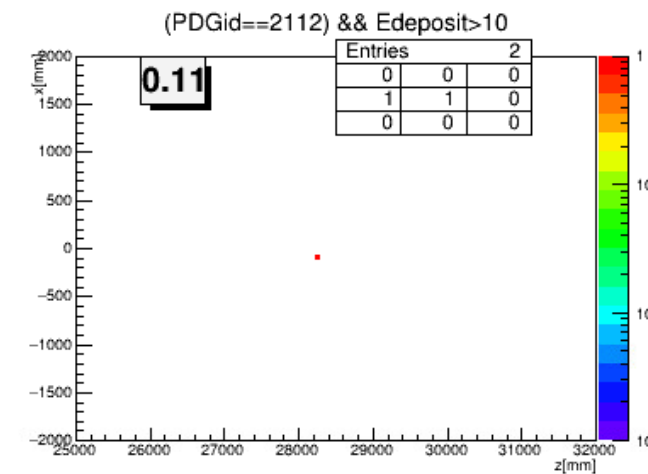
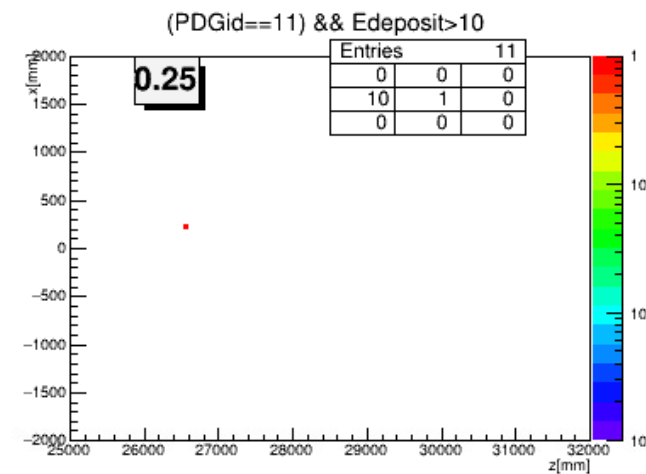
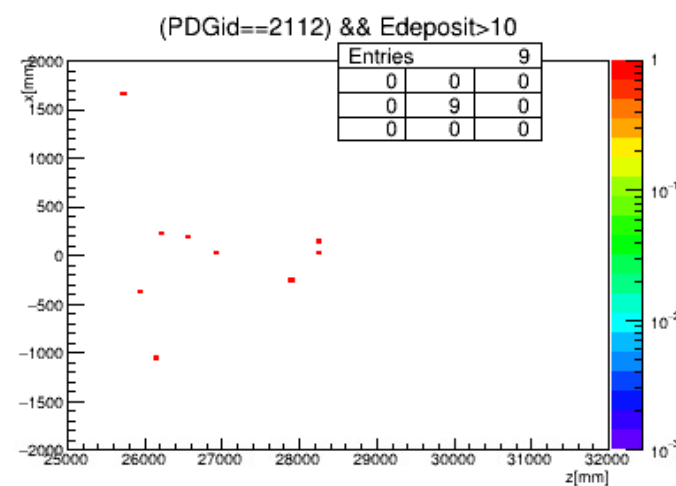
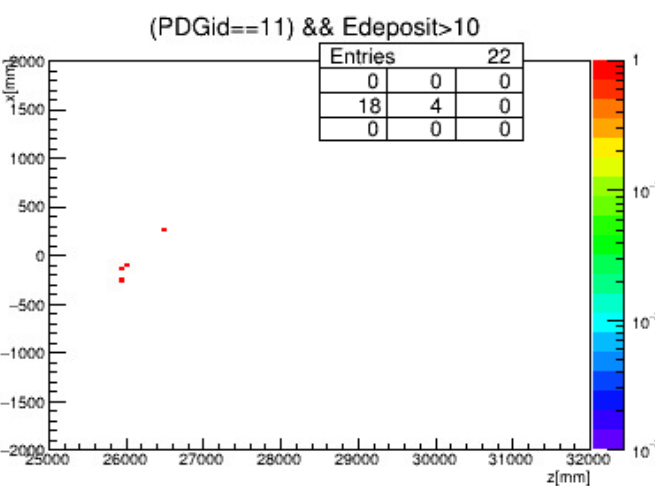
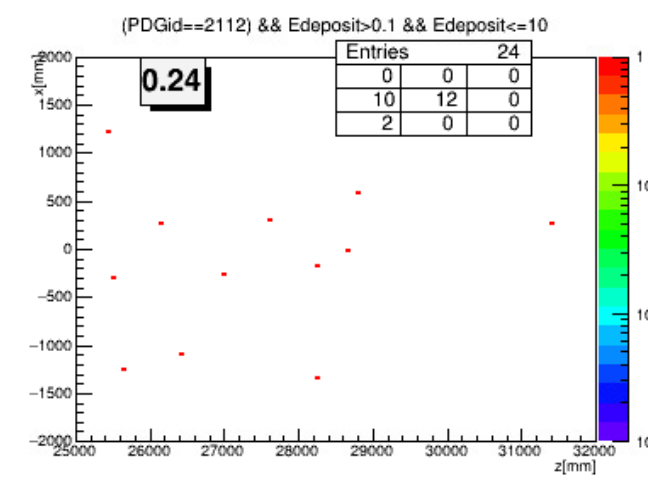
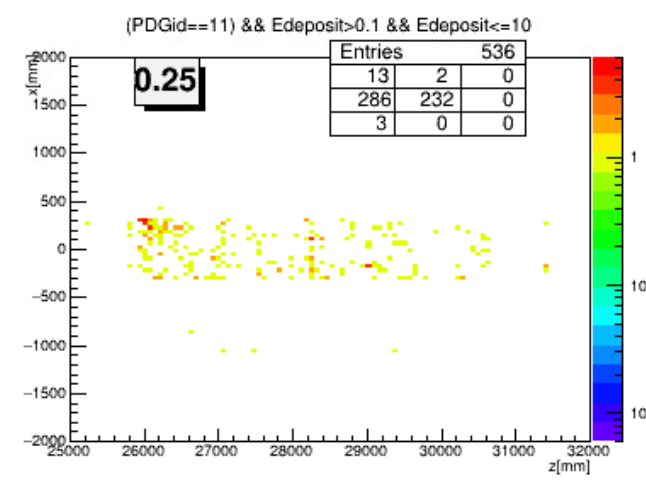
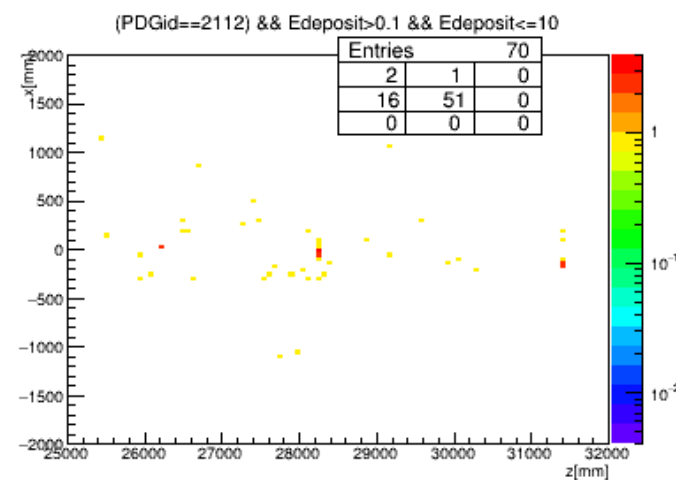
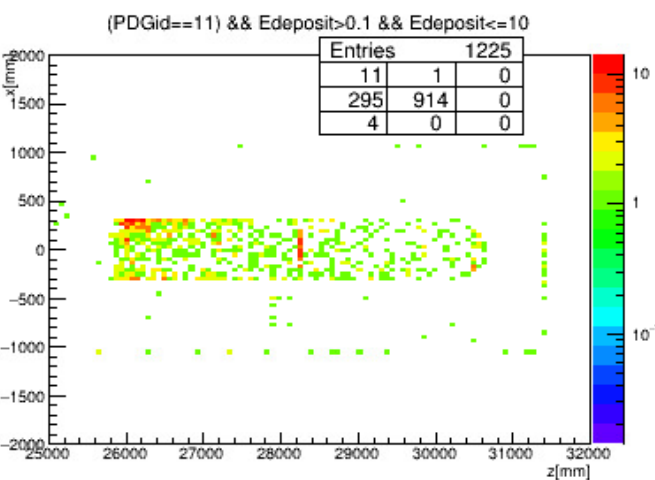
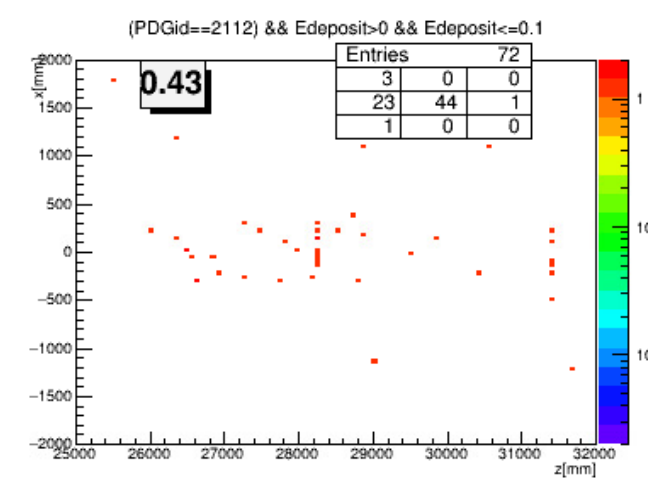
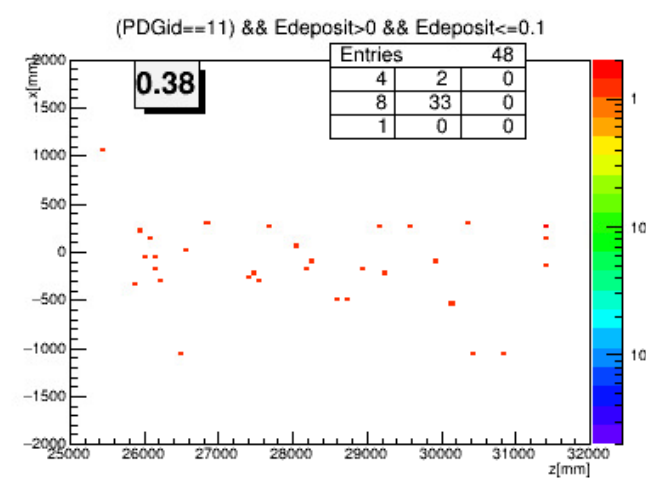


# PREX2 - comparison

## current setup



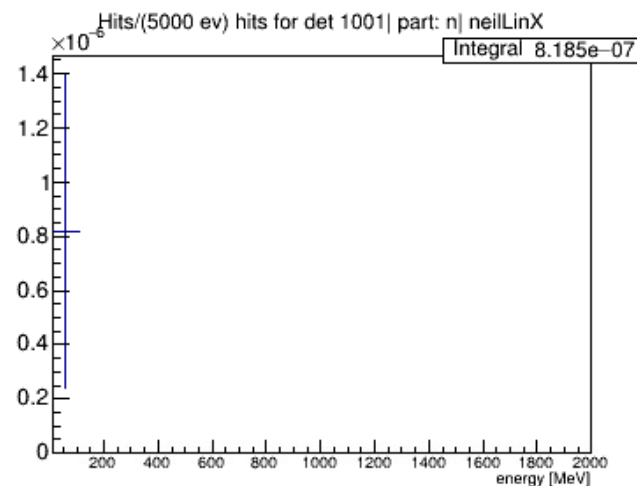
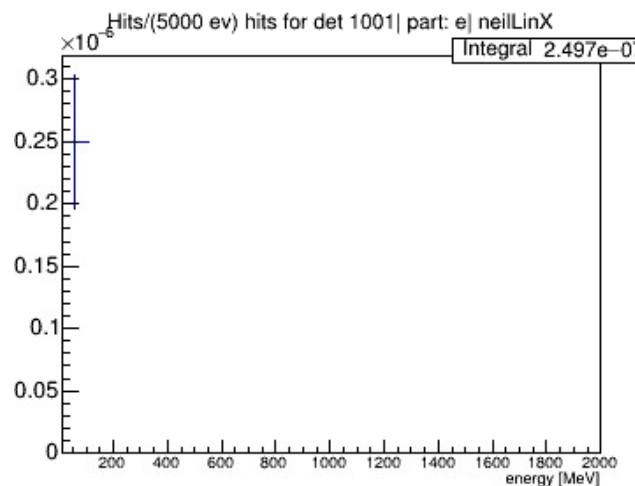
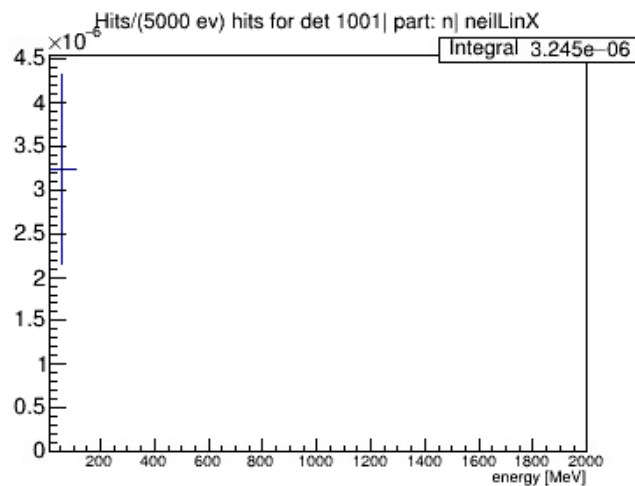
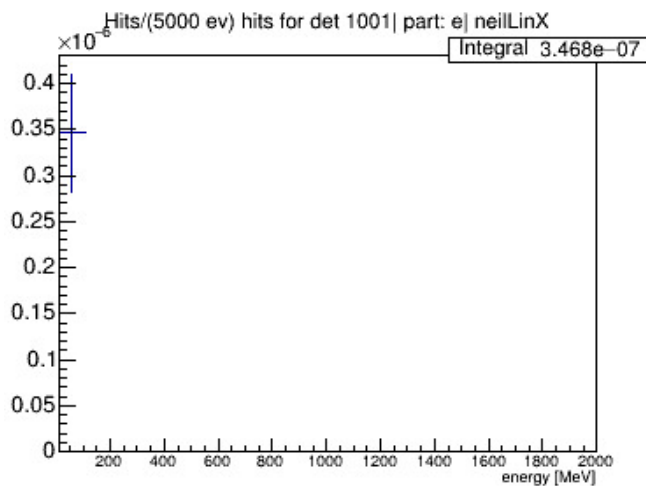
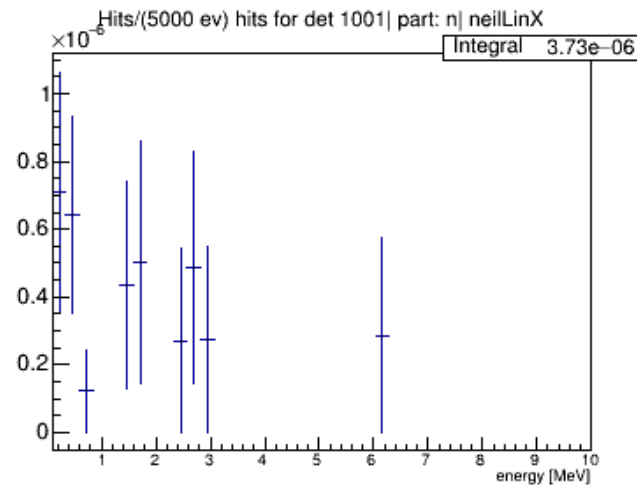
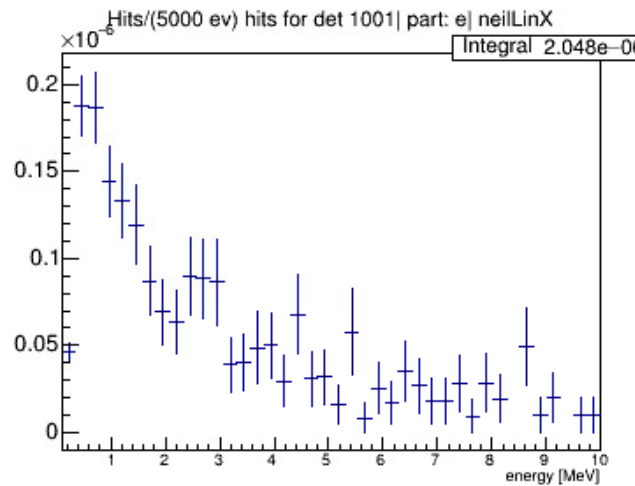
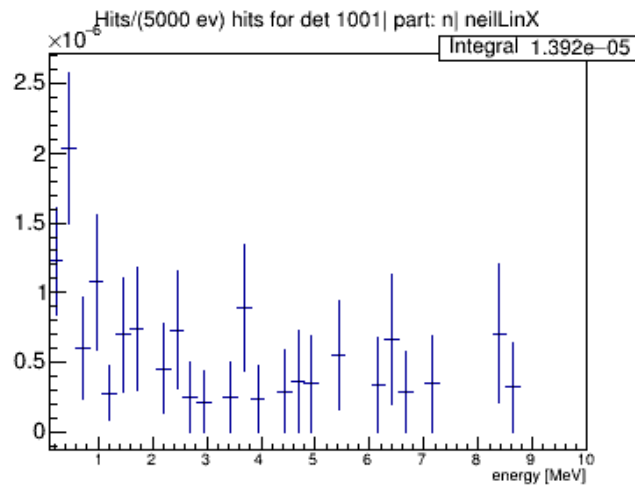
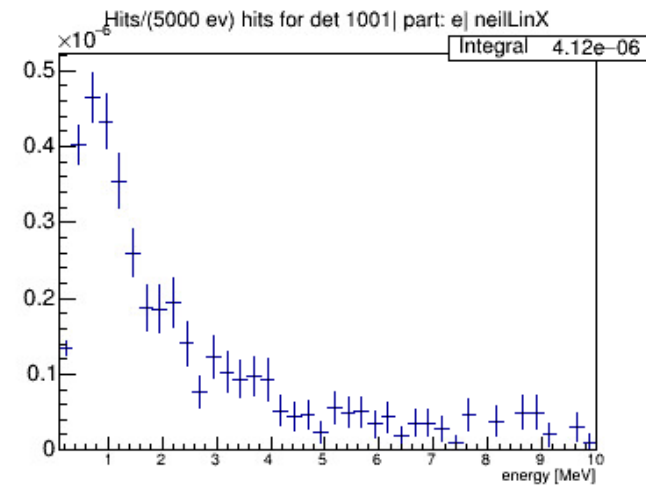
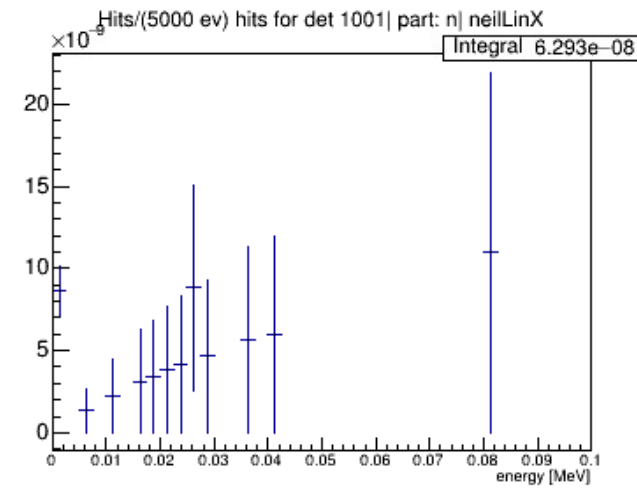
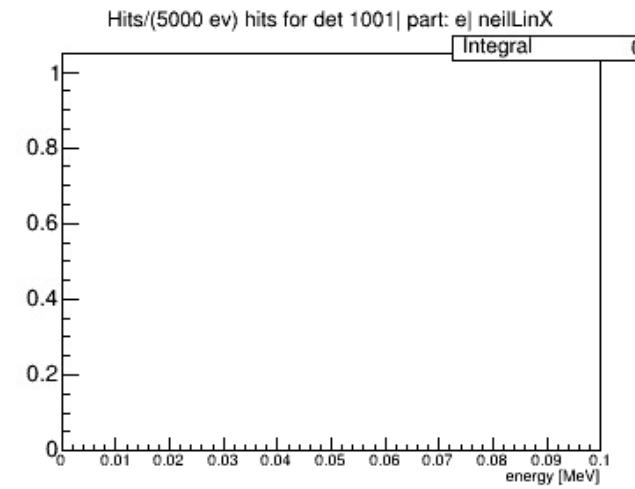
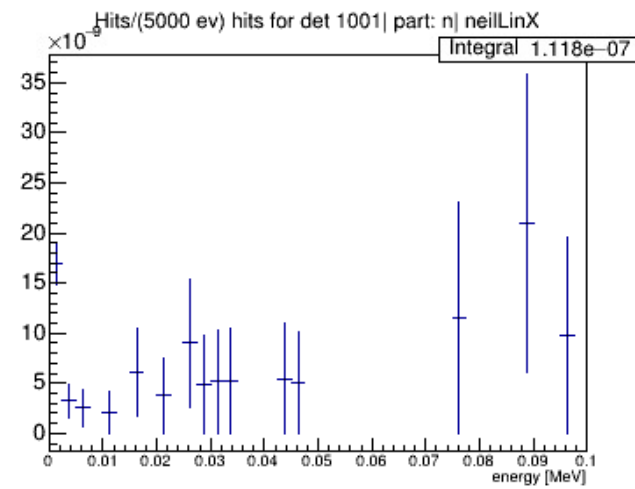
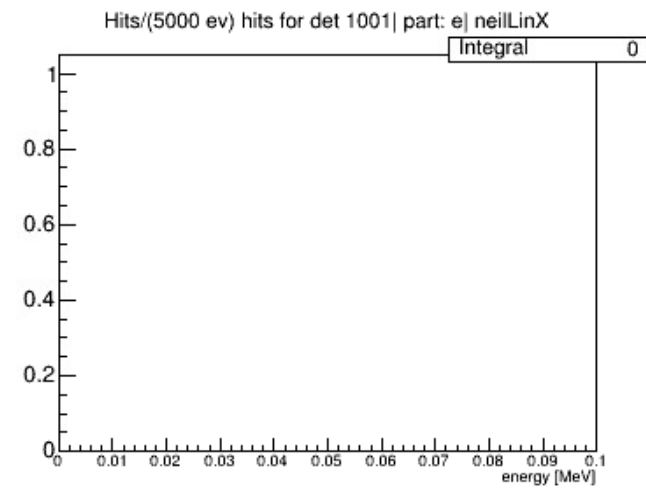
## current setup + 4 in Donut+ 1 ft concrete shield





# PREX2 - comparison

## current setup

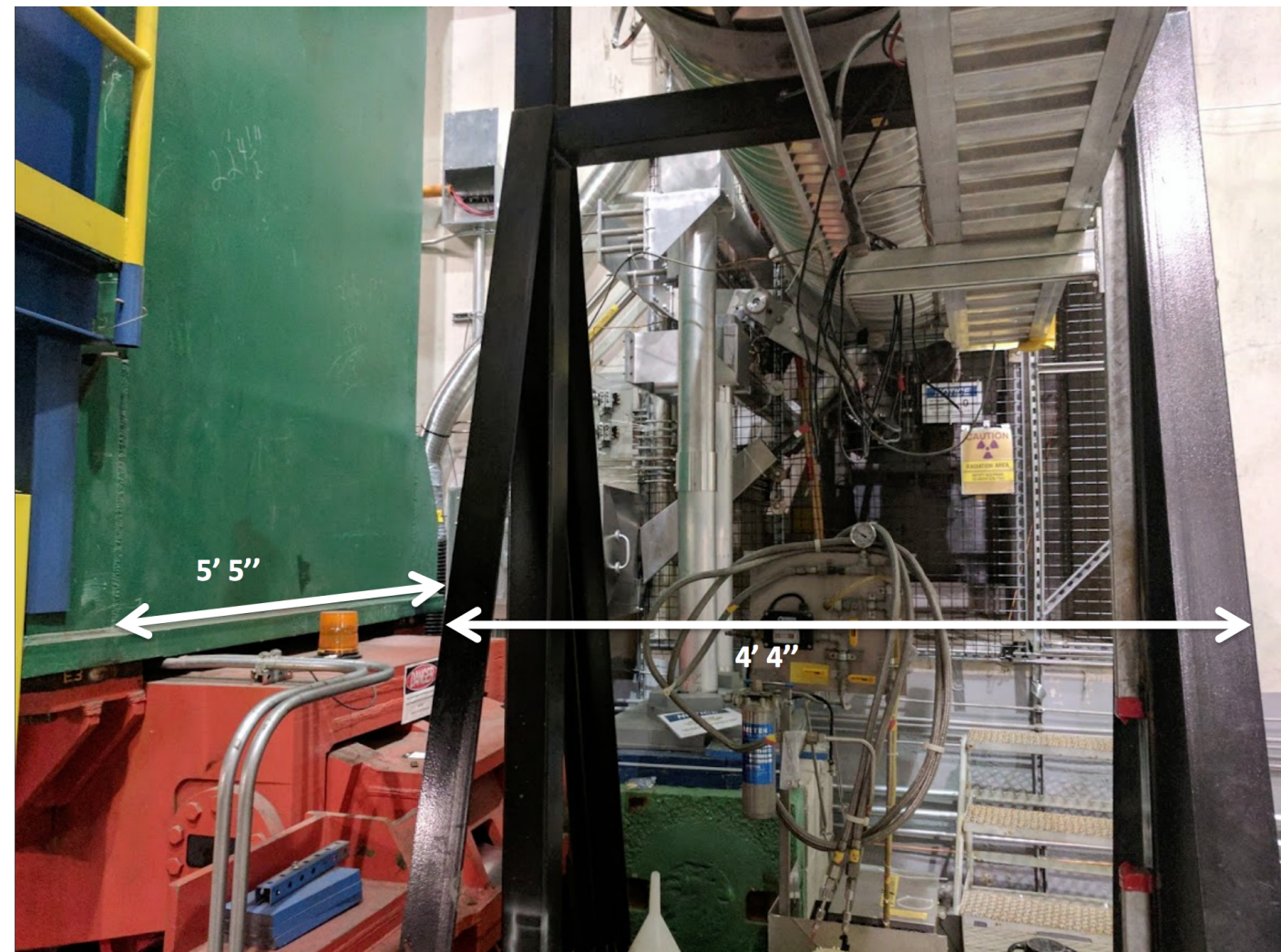
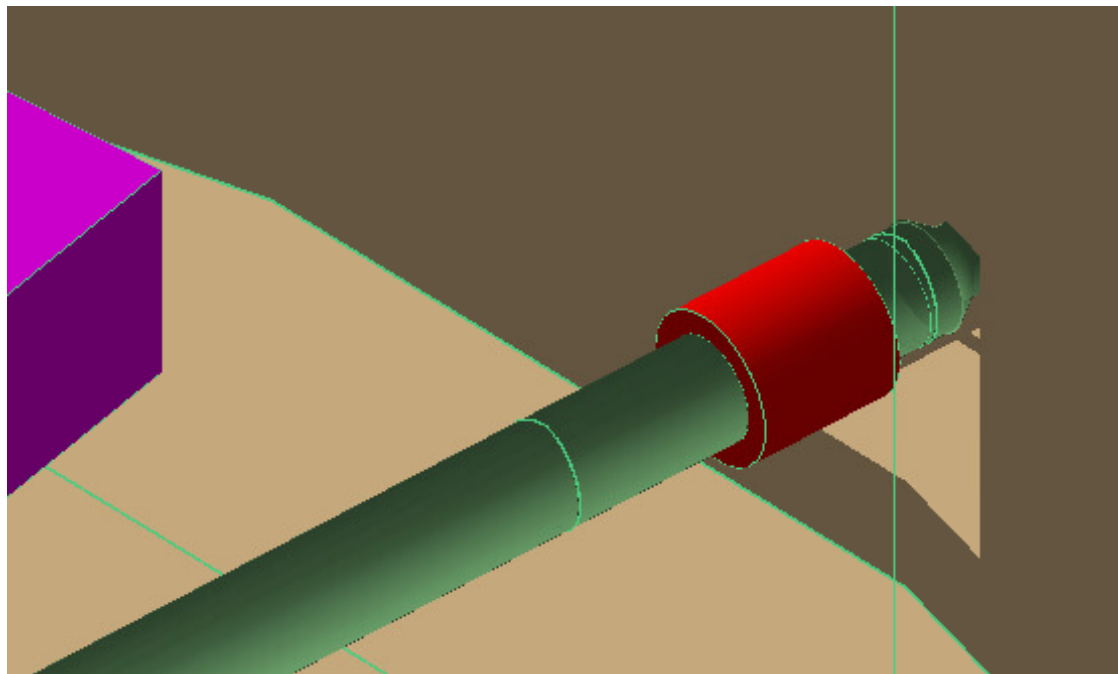


## current setup + 4 in Donut+ 1 ft concrete shield

# PREX2 - comparison

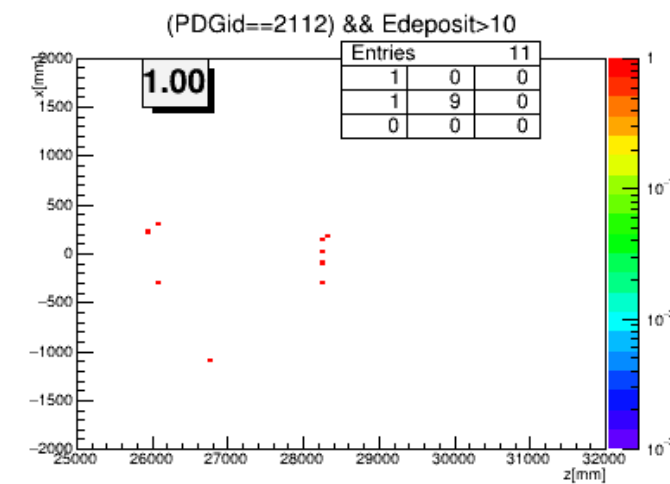
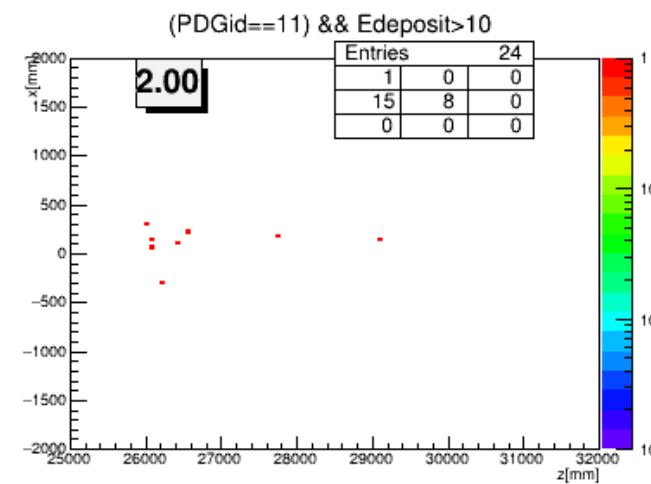
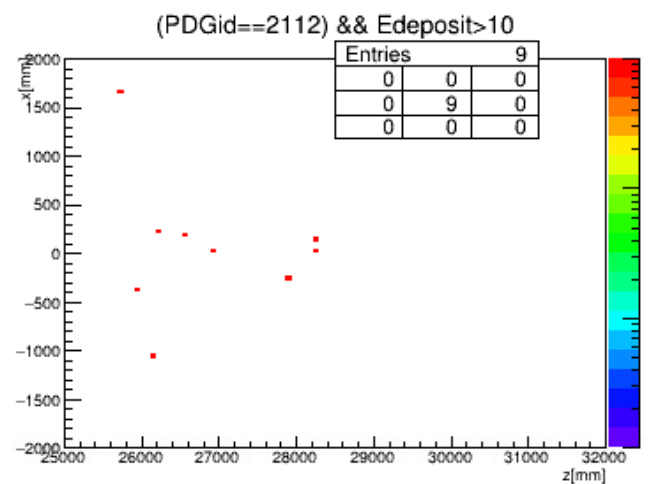
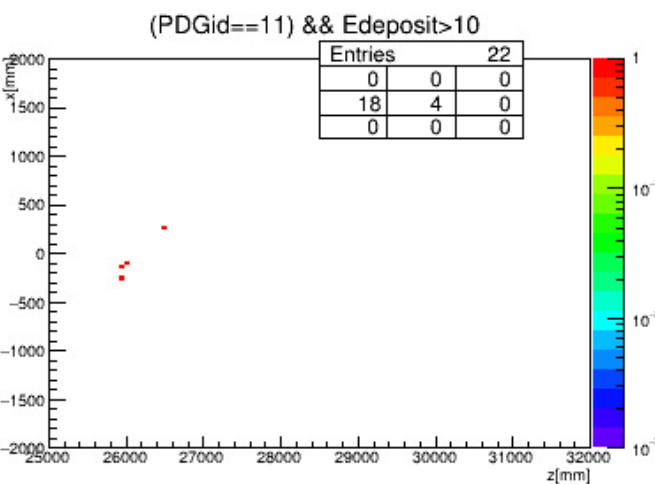
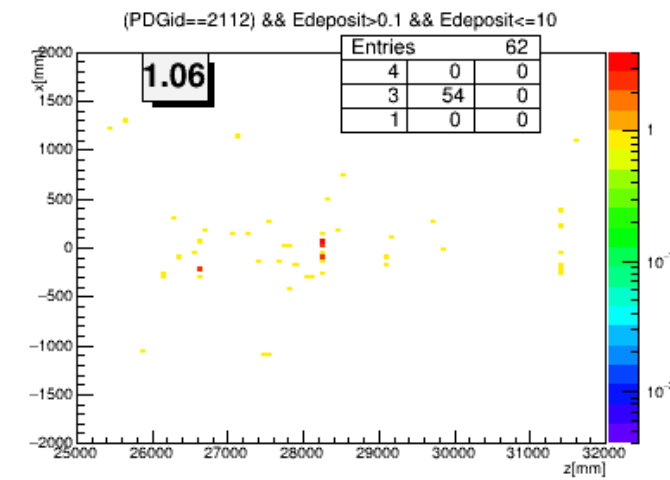
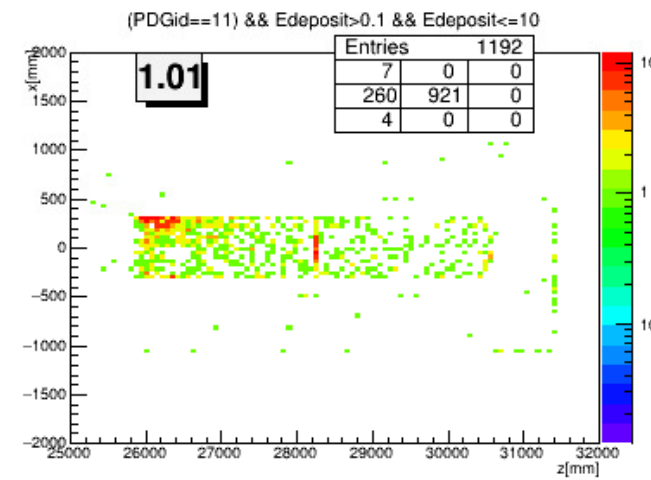
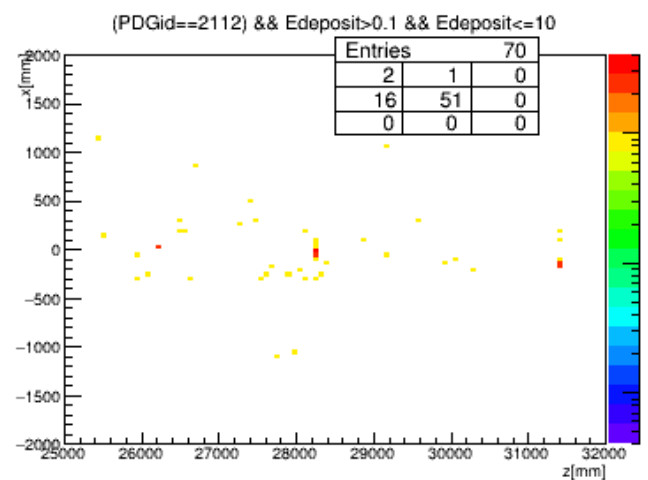
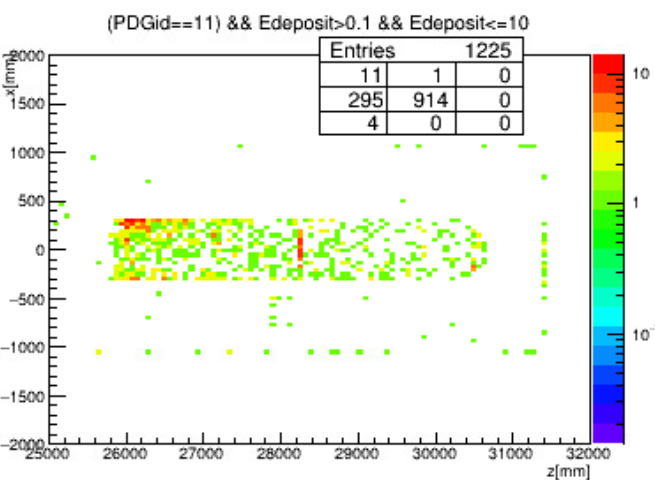
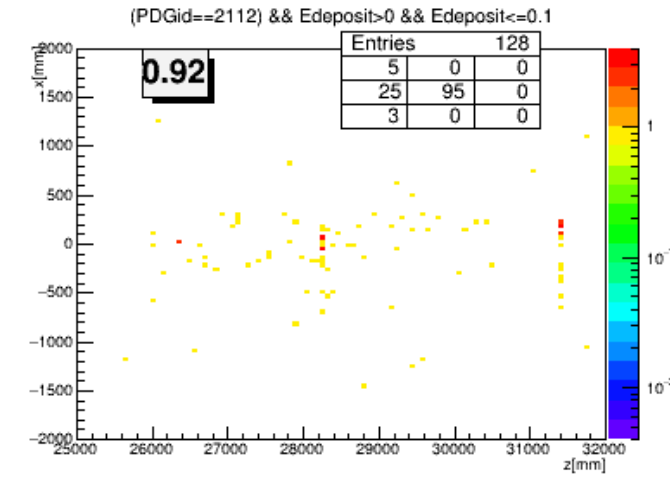
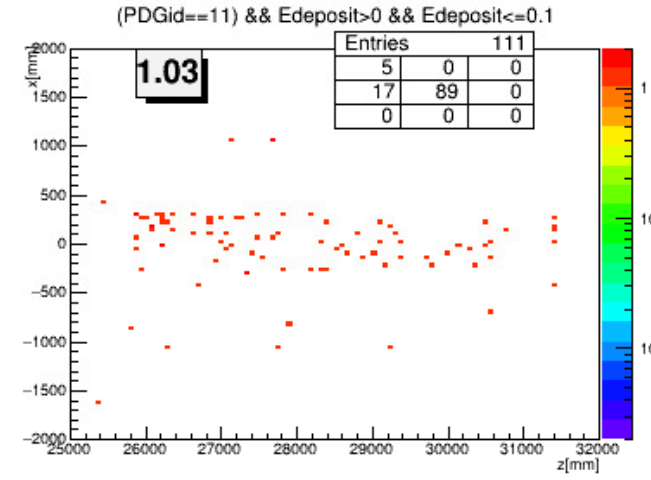
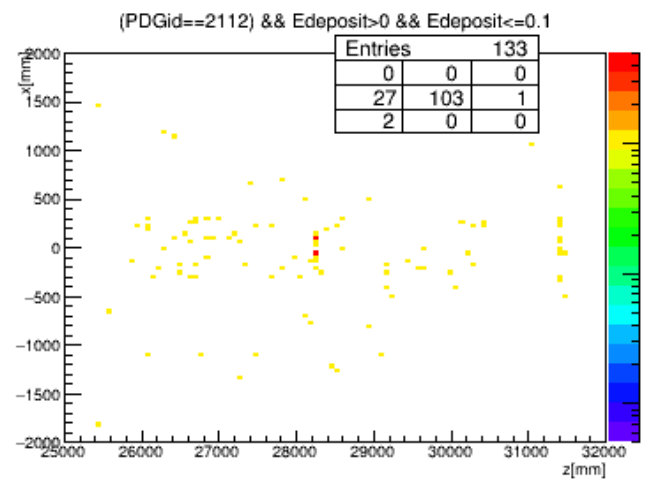
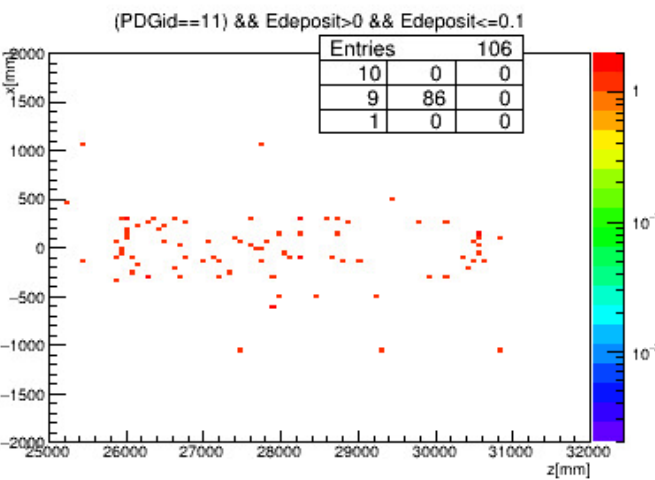
## current setup + donut shield:

- \* 131 cm in z
- \* 20 cm in r (46 to 66 cm)
- \* DS edge ~50 cm from the edge of the hall (would require some refinement to fit in)



# PREX2 - comparison

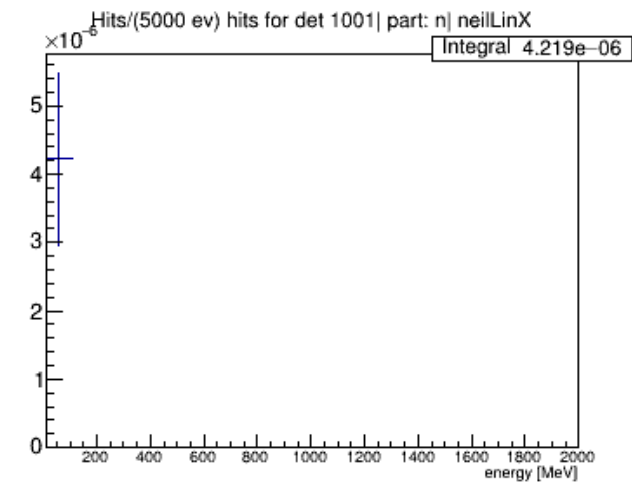
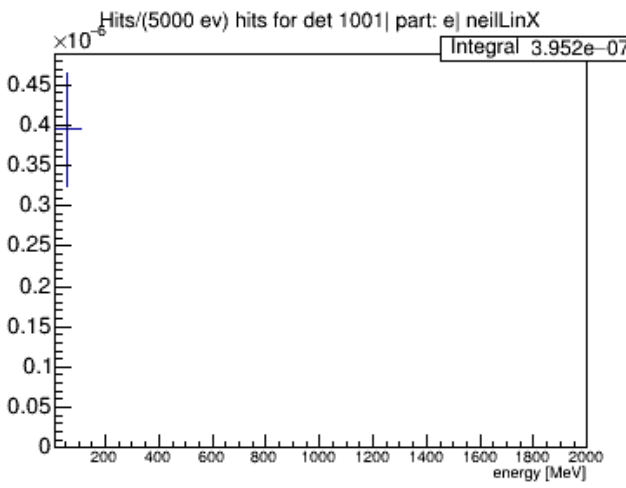
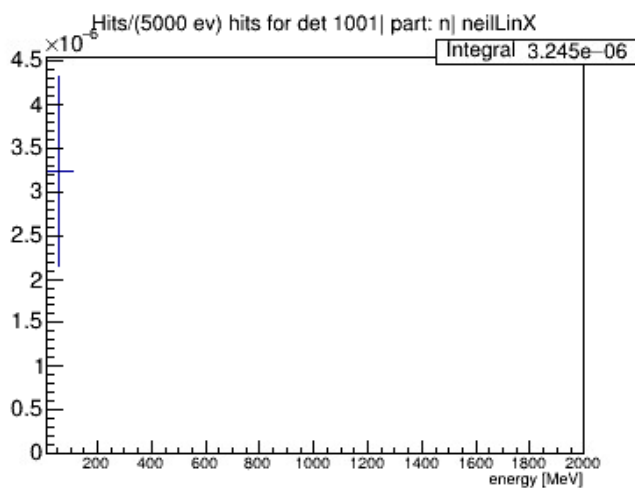
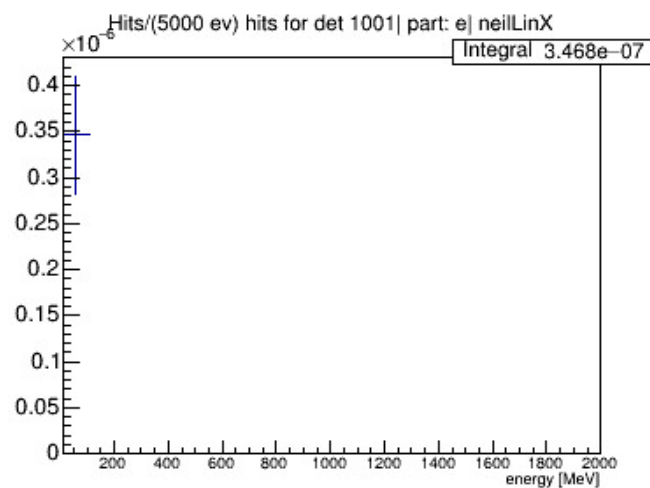
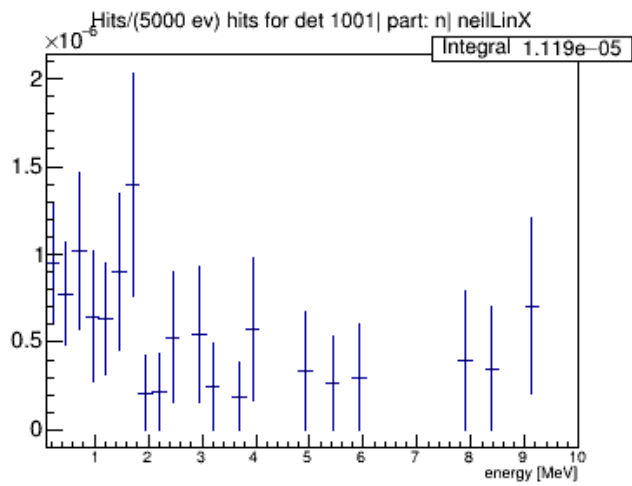
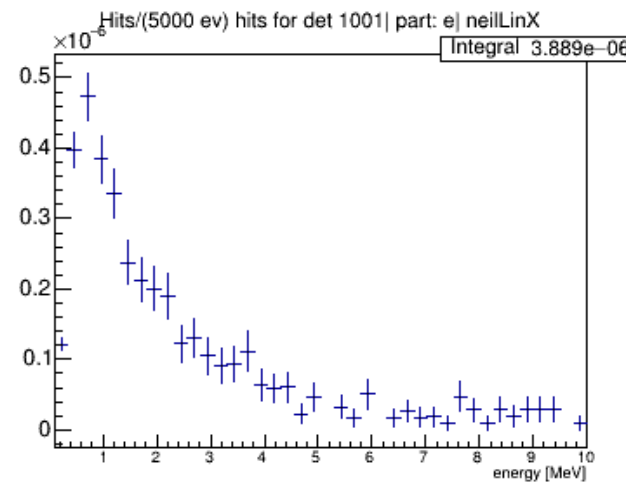
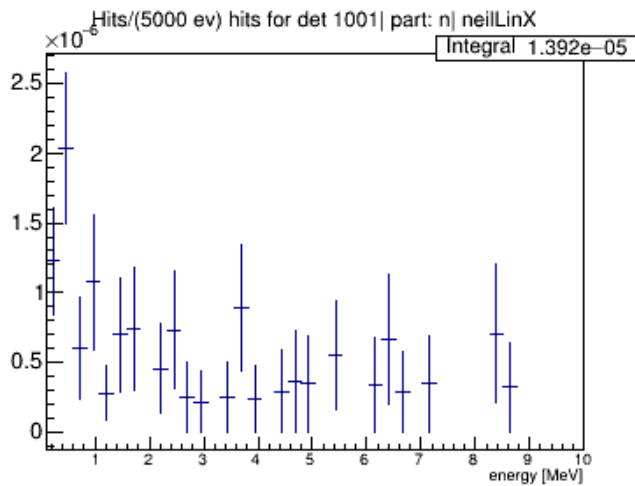
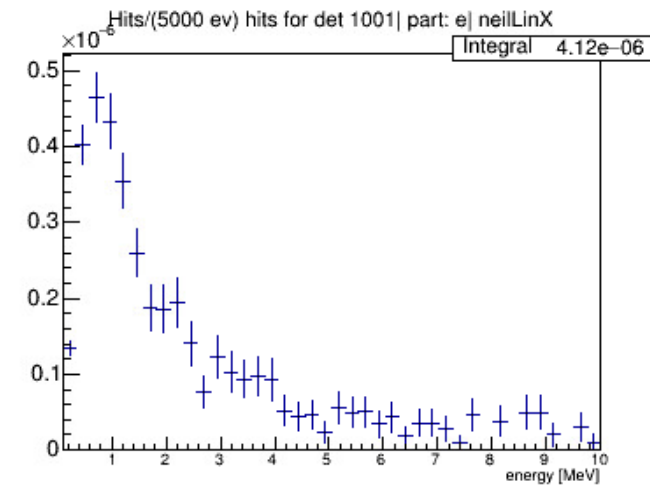
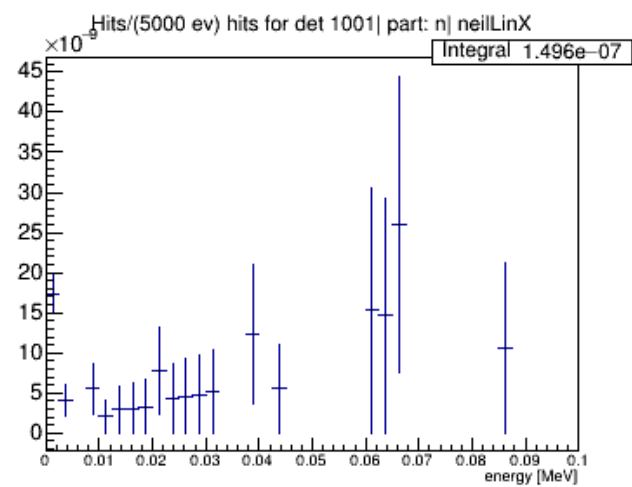
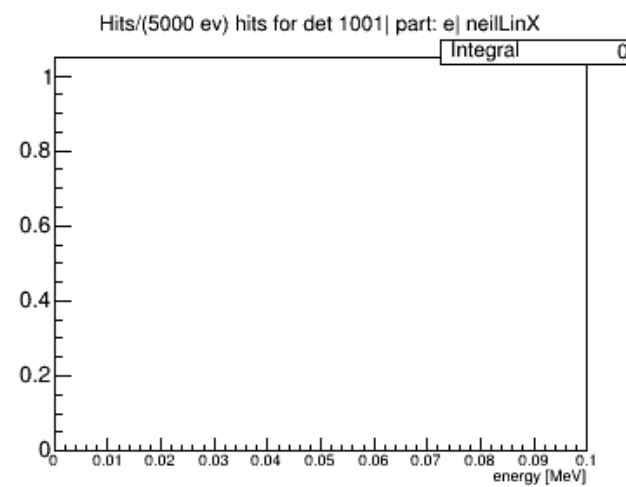
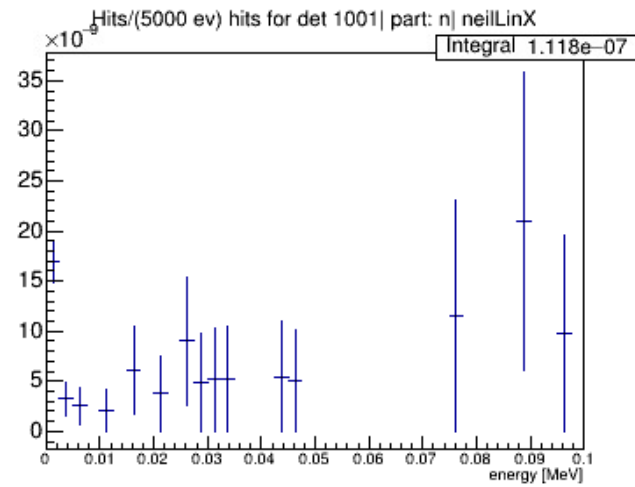
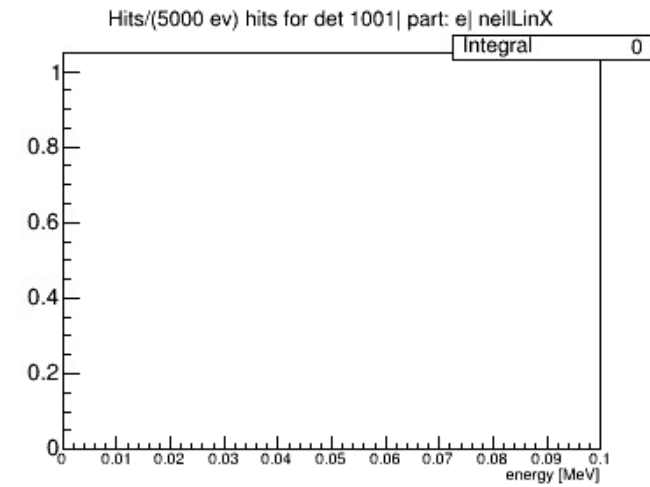
## current setup





# PREX2 - comparison

## current setup



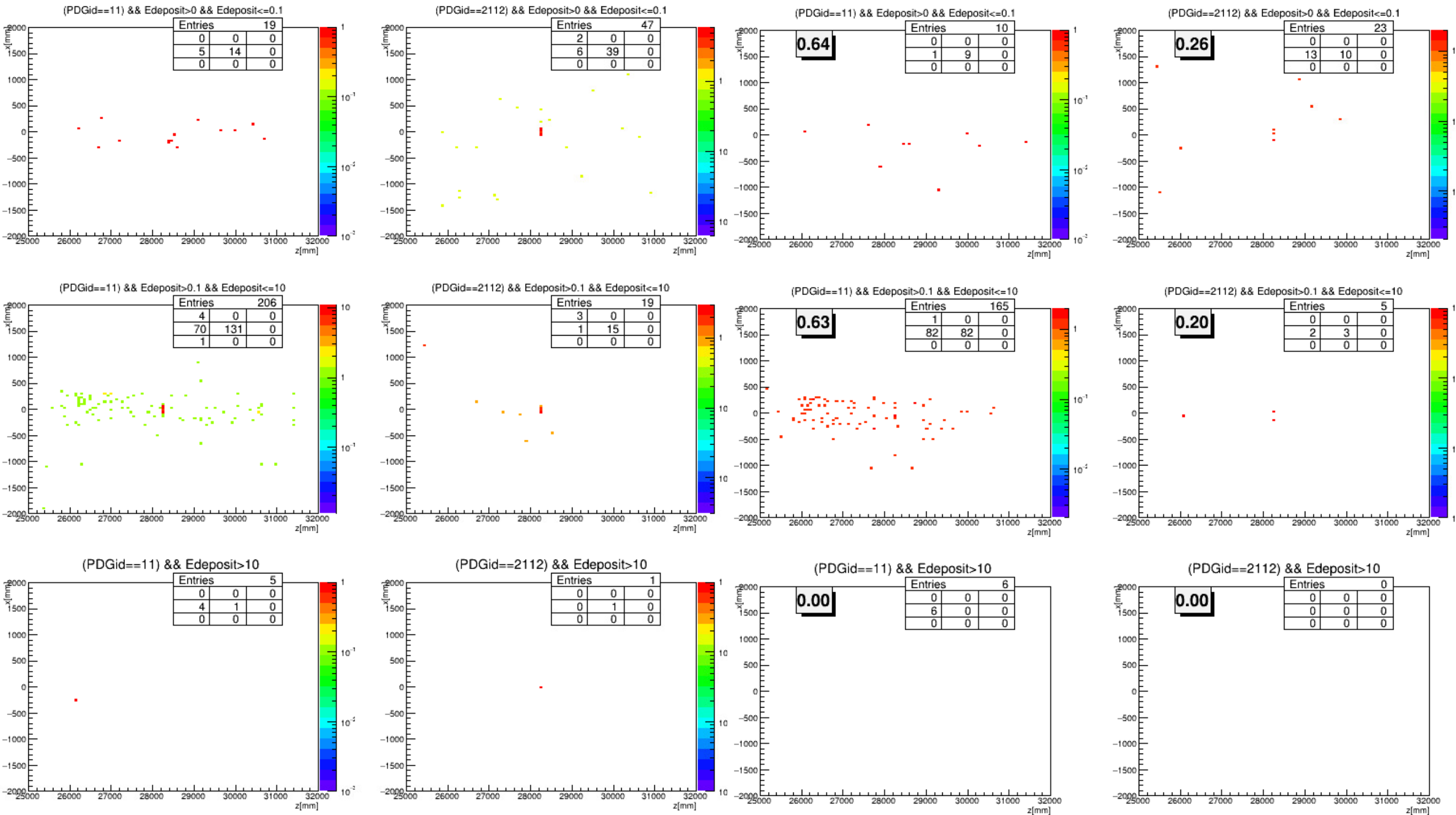
## current setup + donut shield



# CREX - comparison

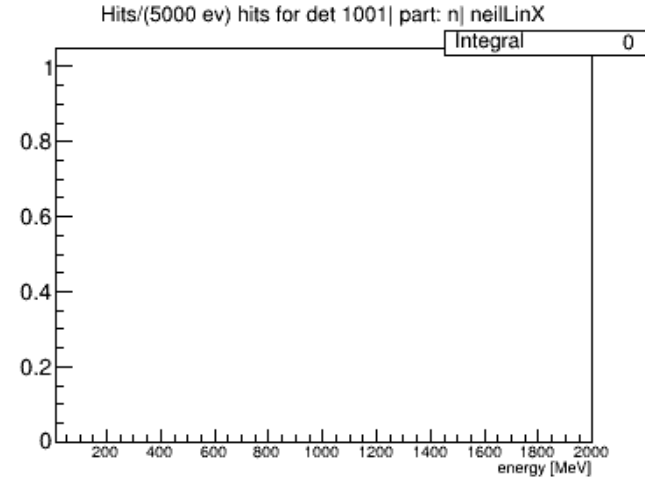
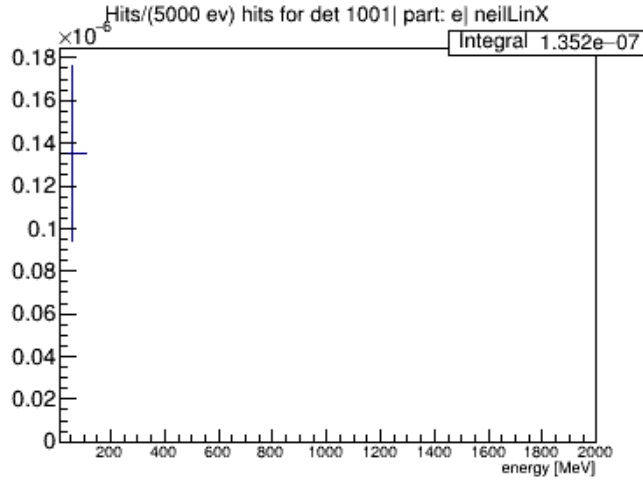
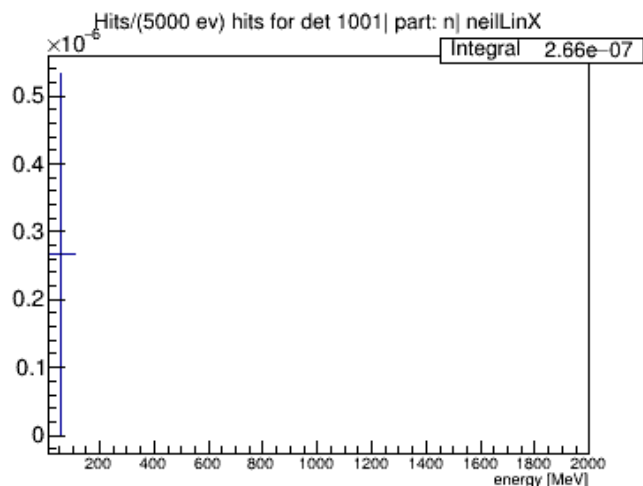
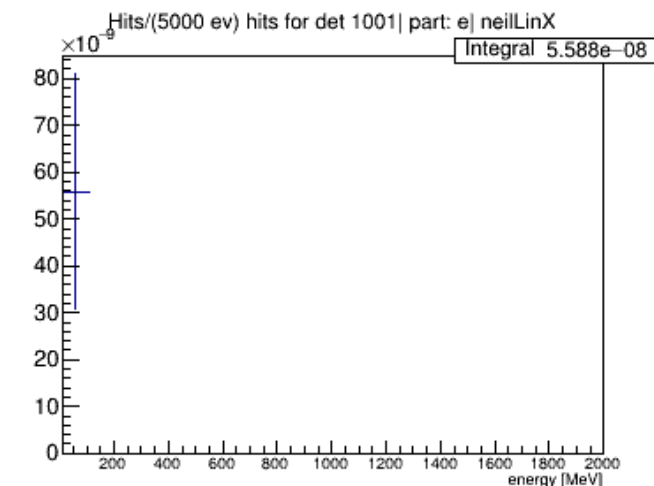
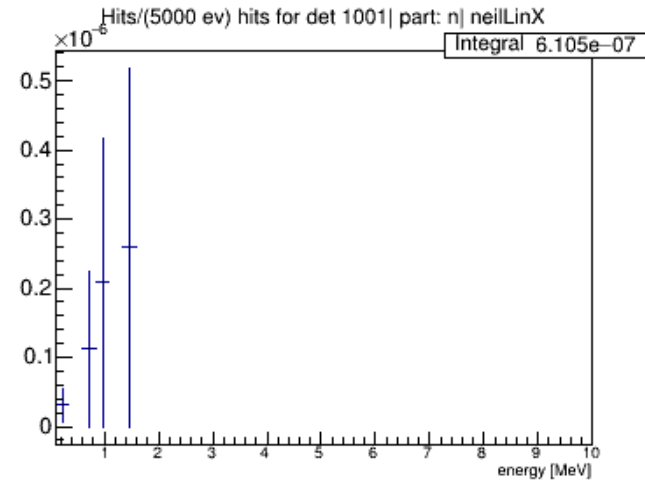
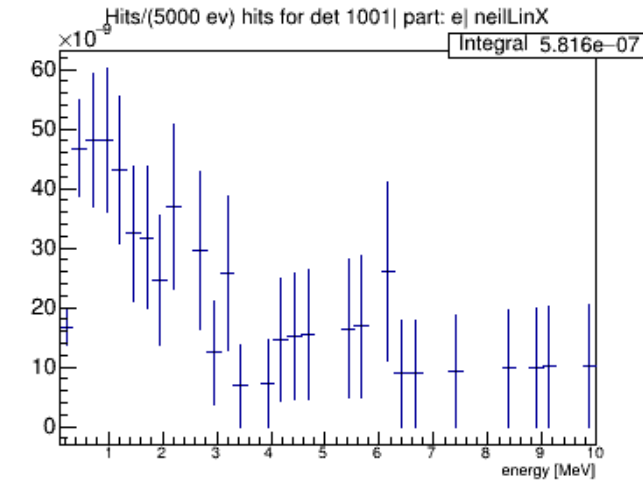
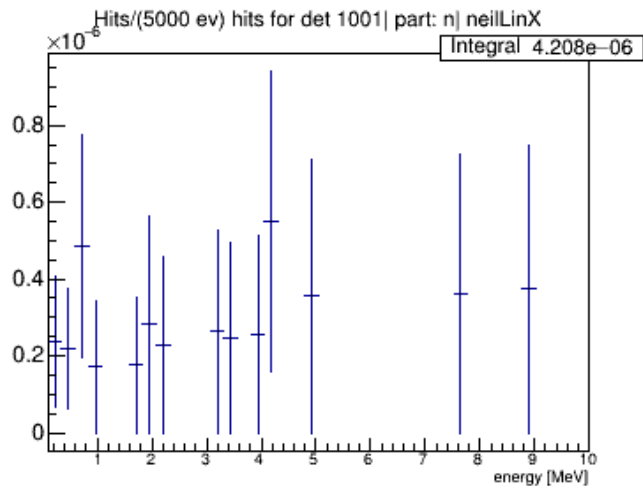
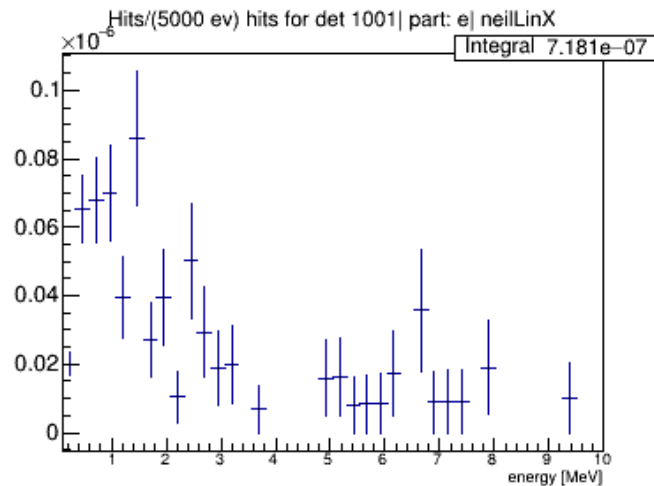
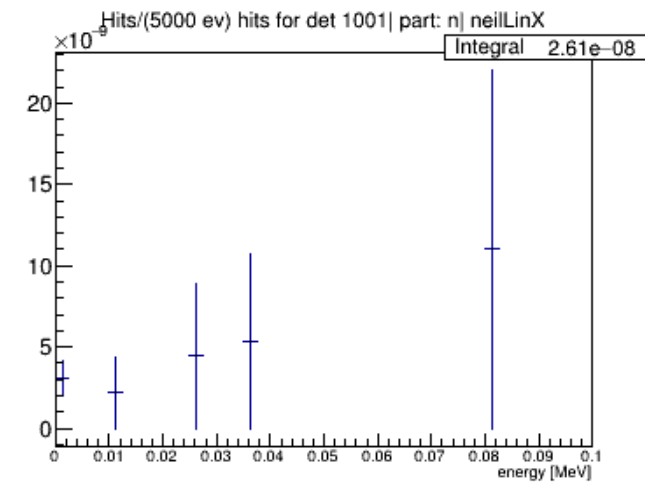
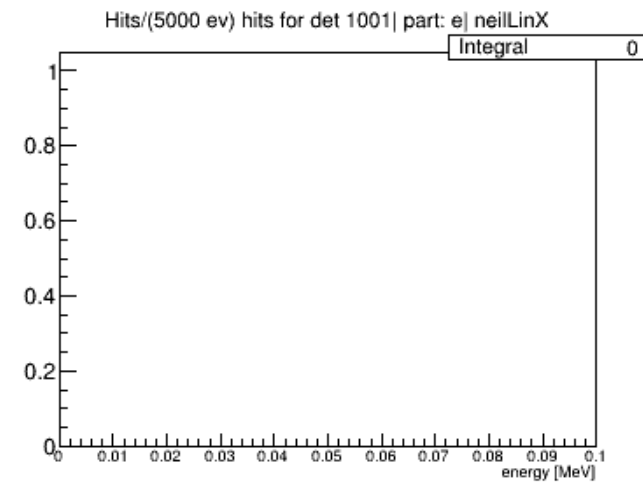
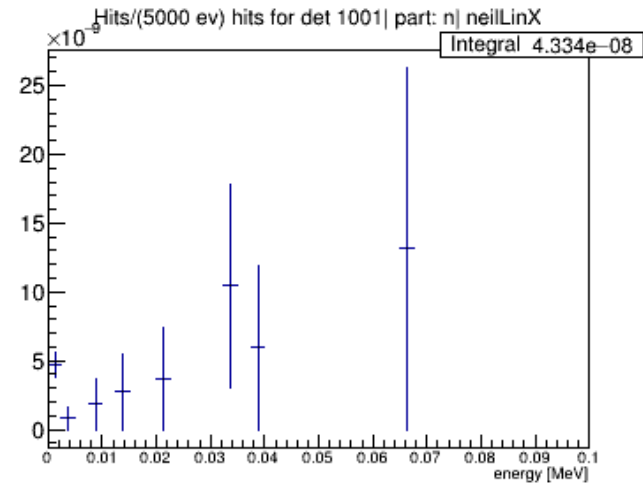
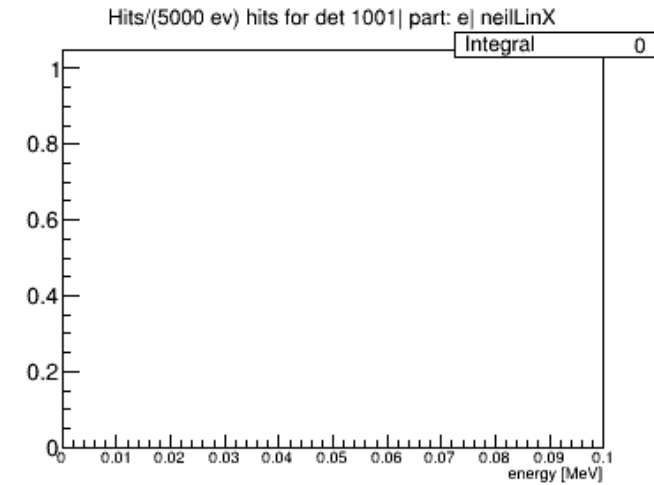
## current setup

## current setup + 4 in donut



# CREX - comparison

## current setup

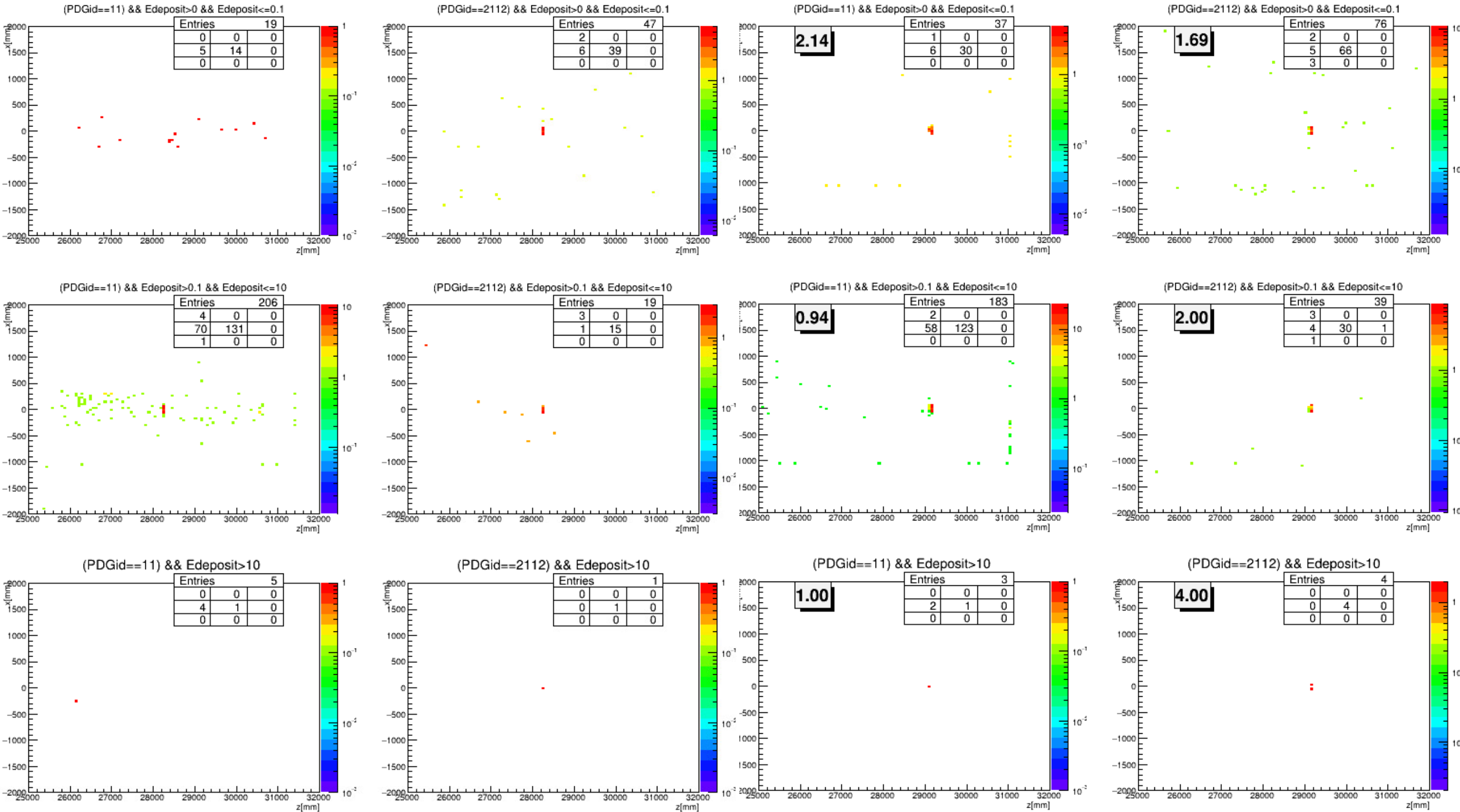


## current setup + 4 in donut

# CREX - comparison

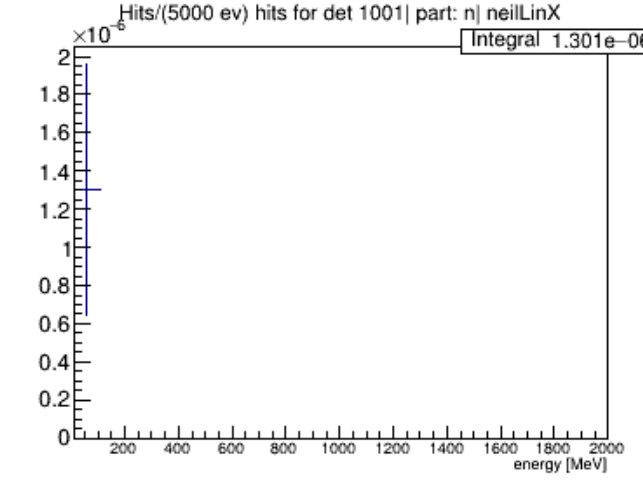
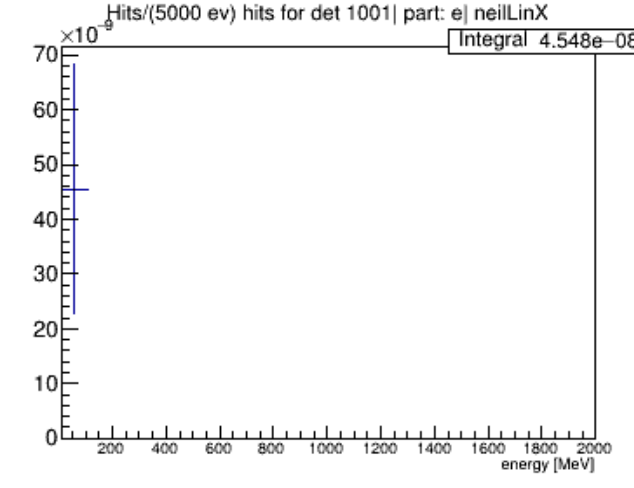
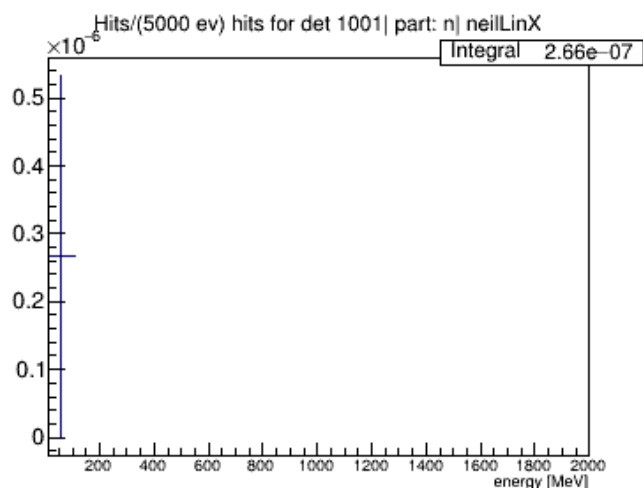
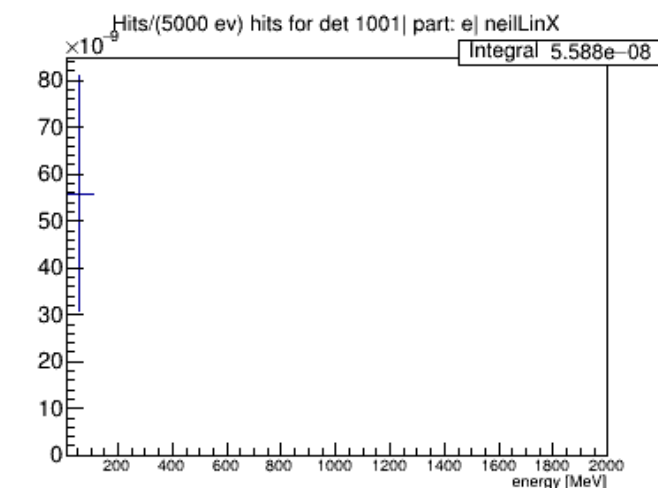
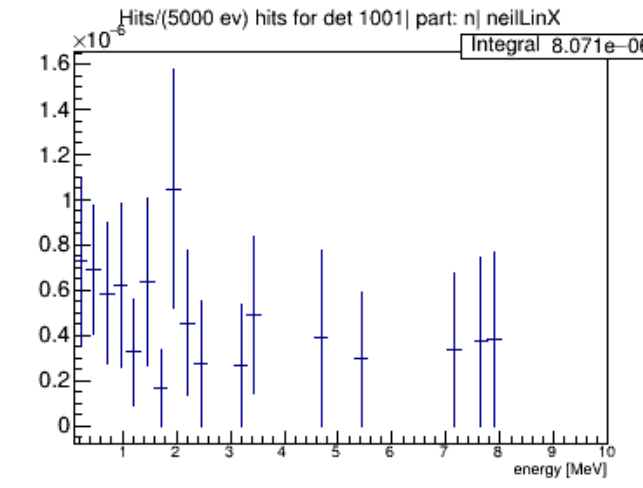
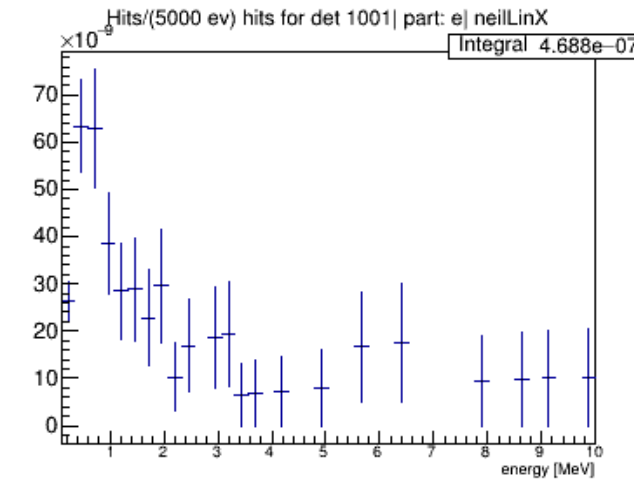
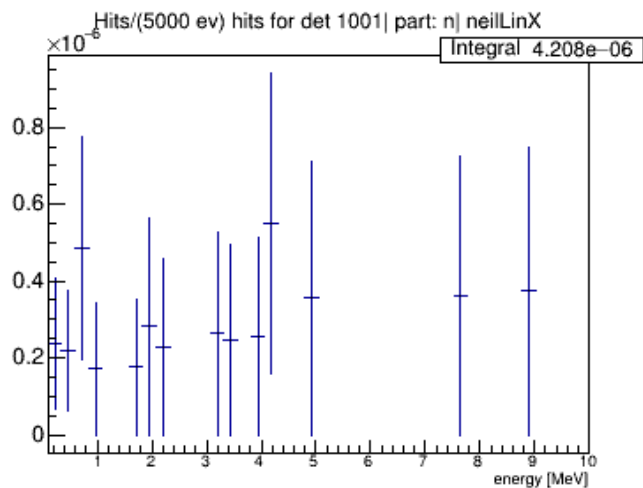
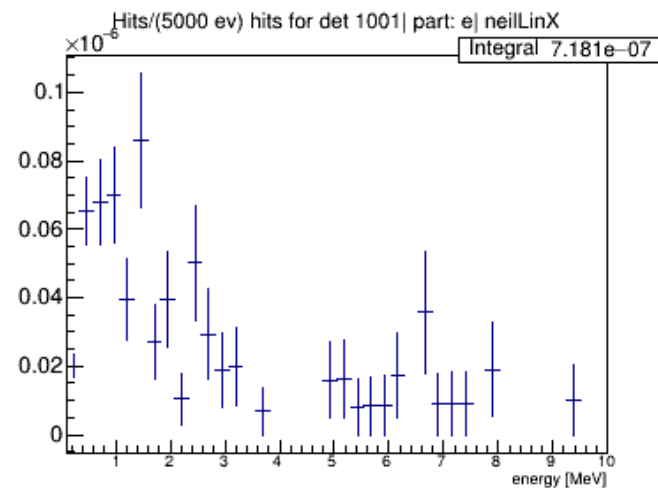
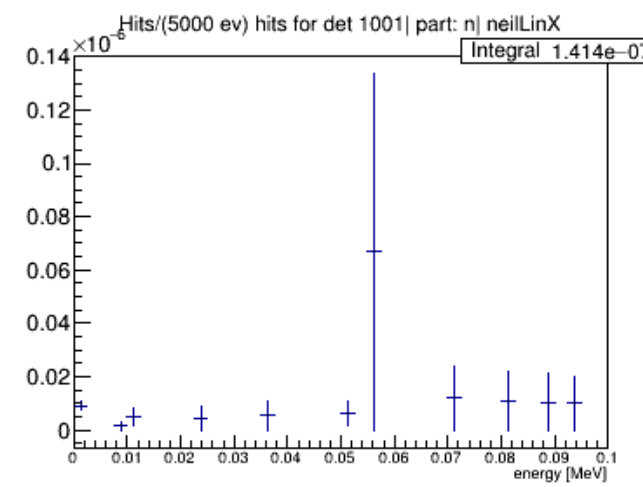
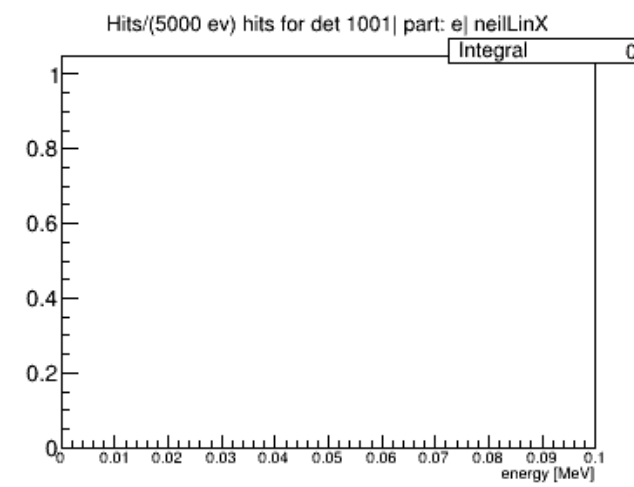
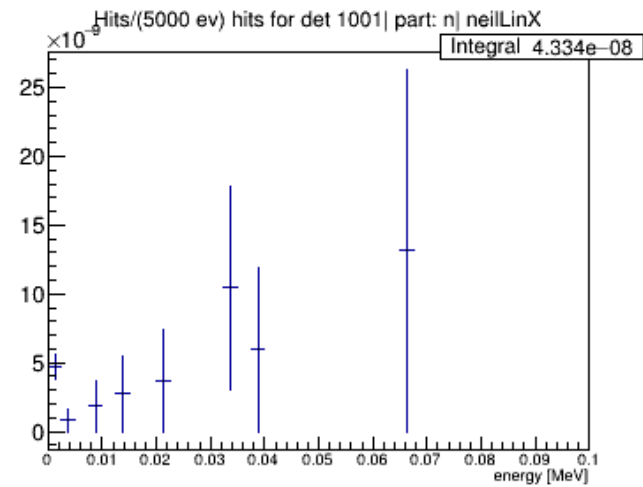
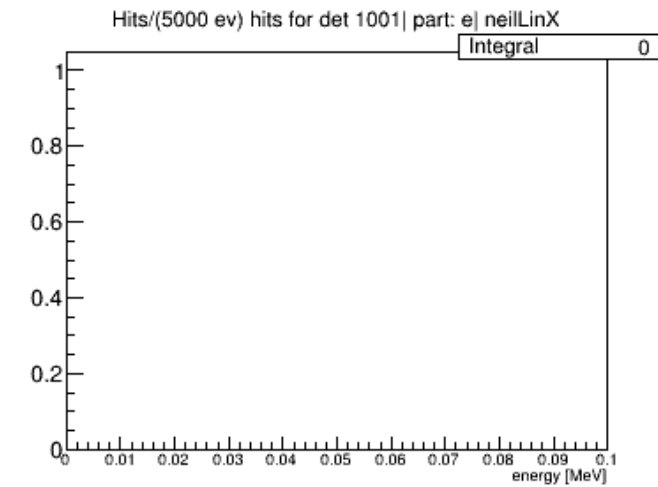
## PREX1 dump setup

### current setup



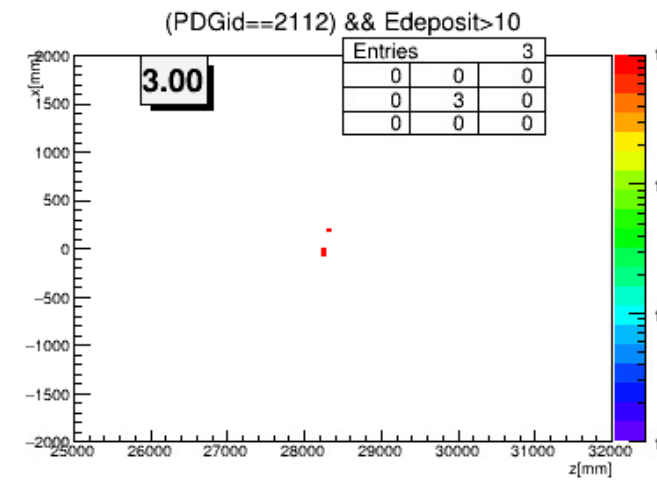
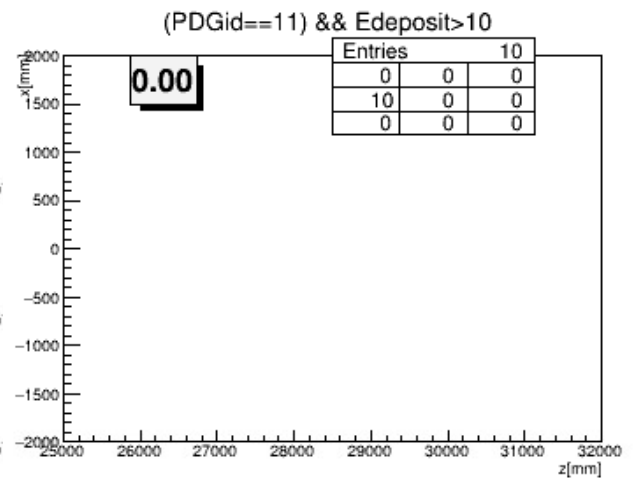
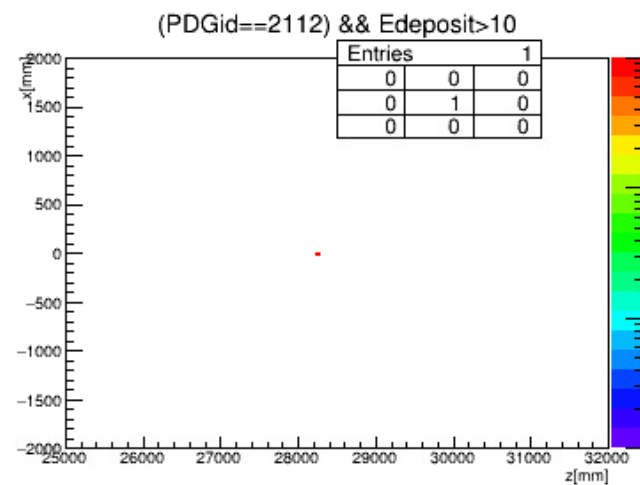
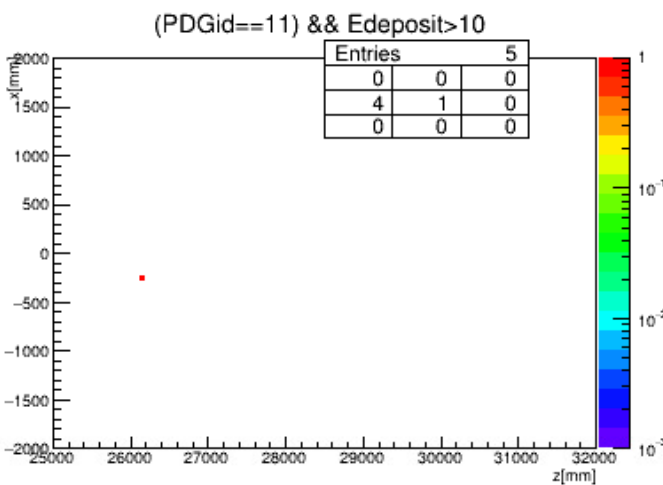
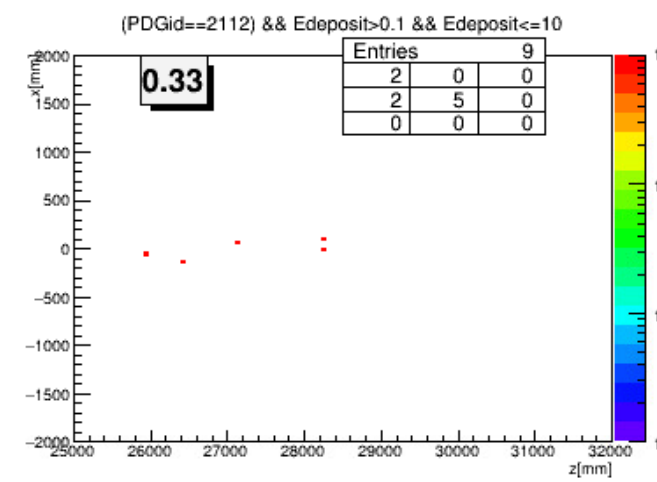
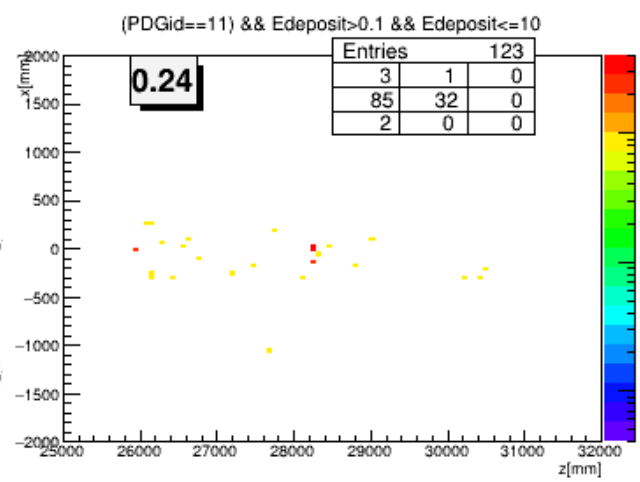
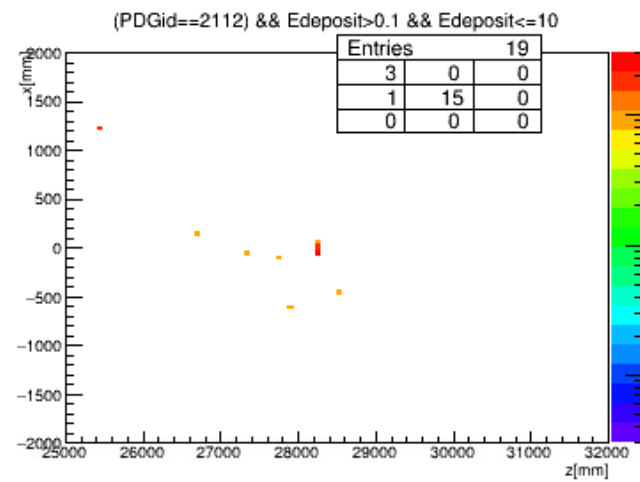
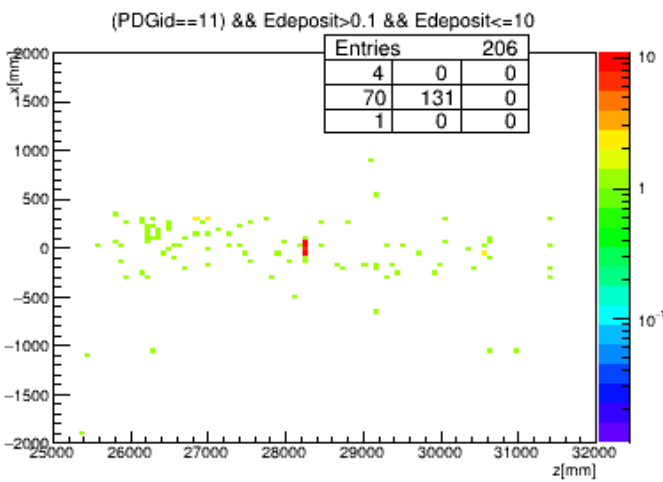
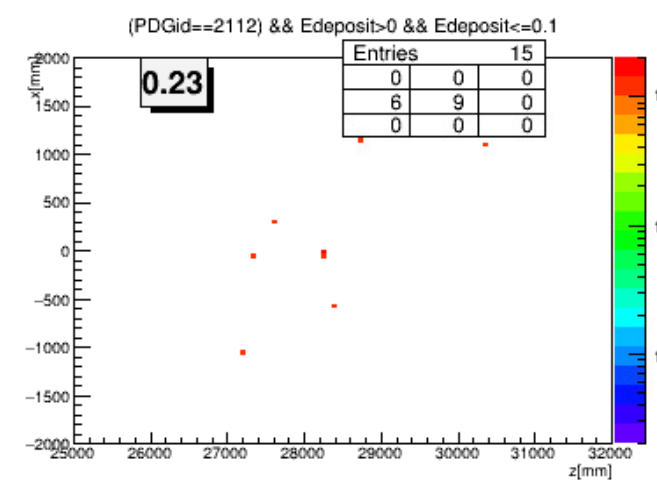
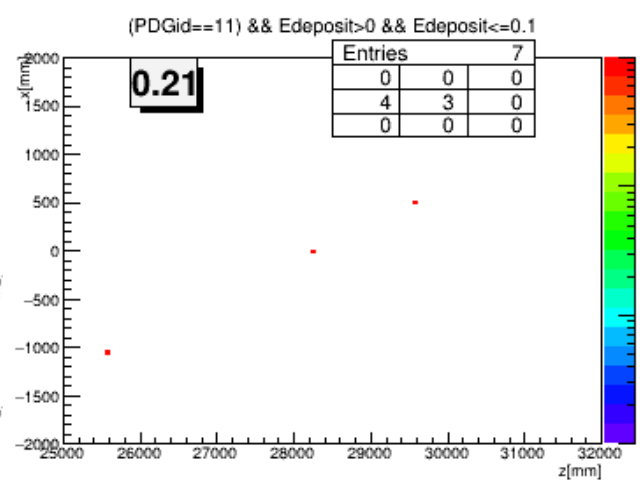
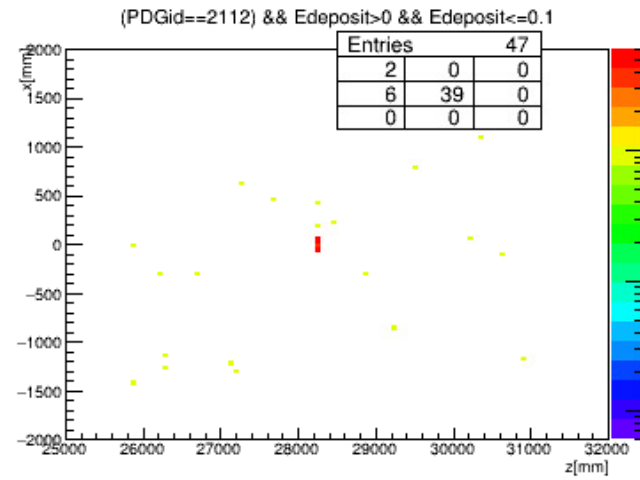
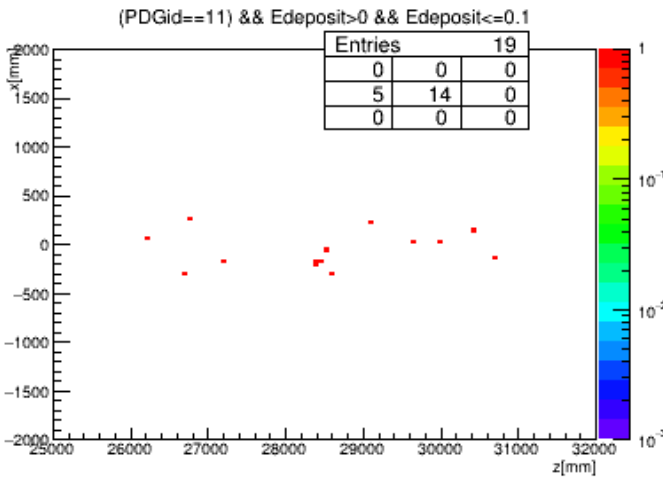
# CREX - comparison

## current setup



# CREX - comparison

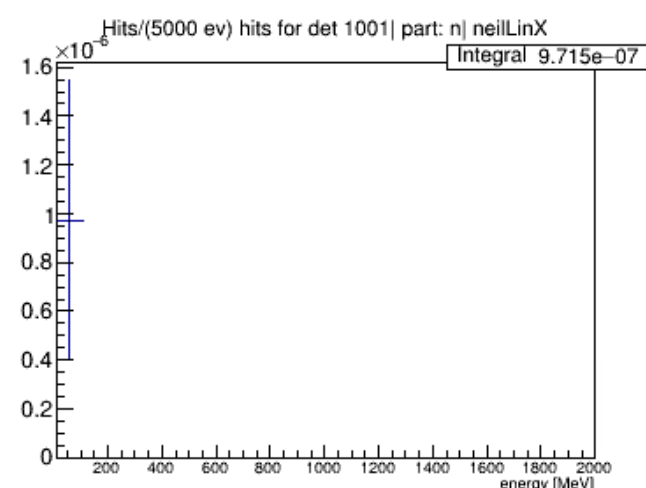
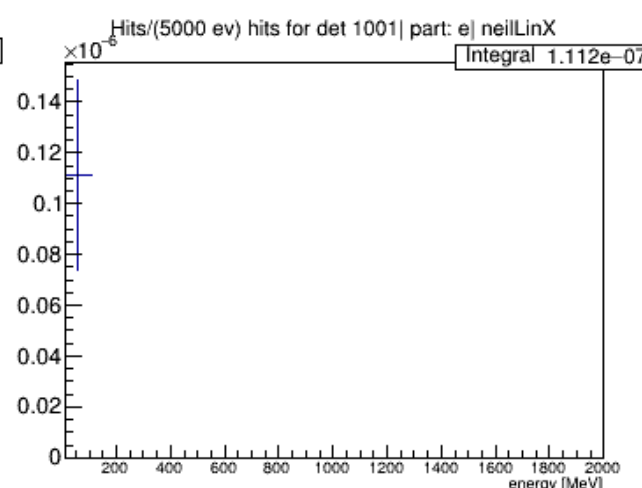
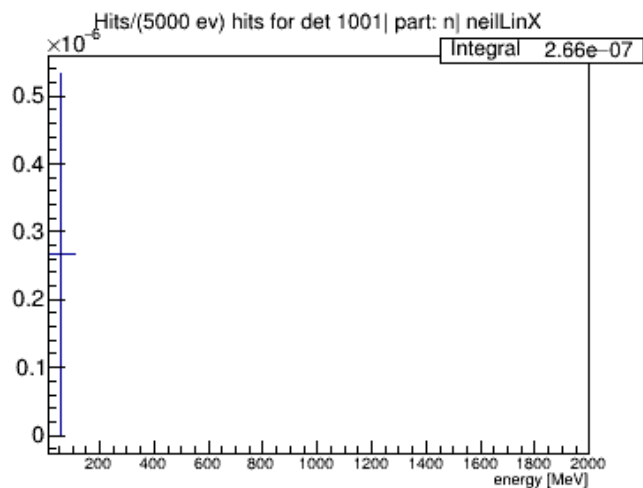
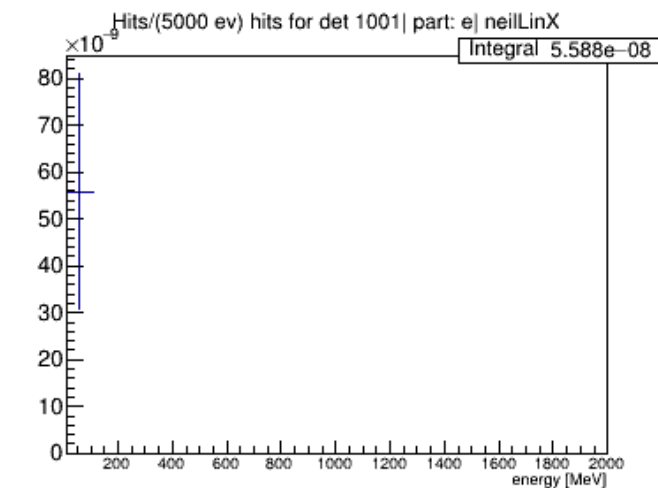
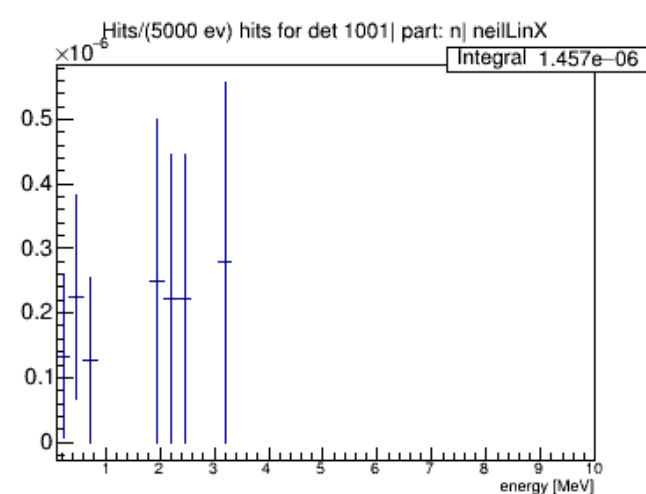
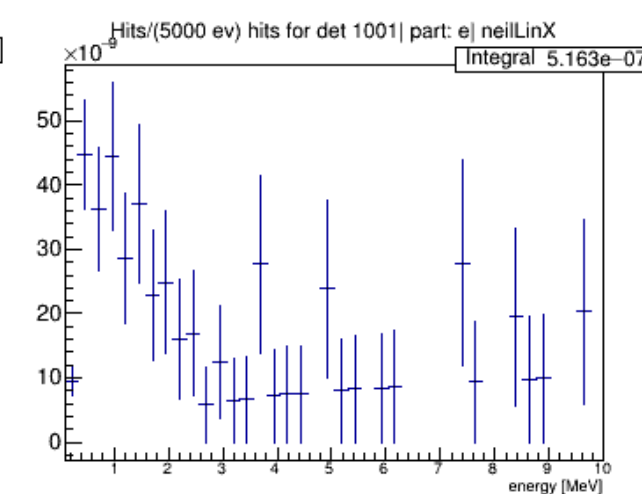
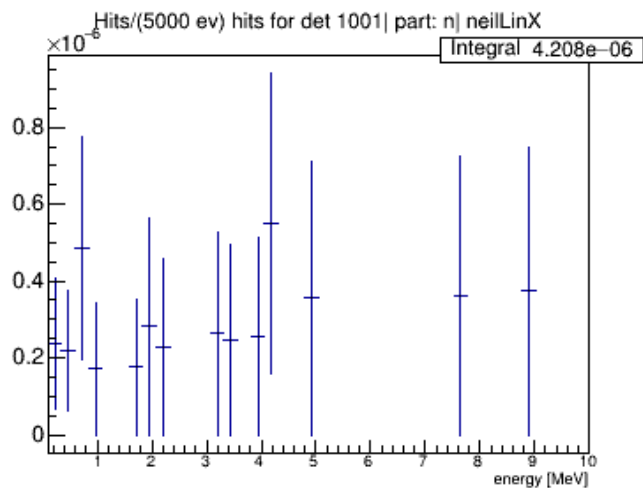
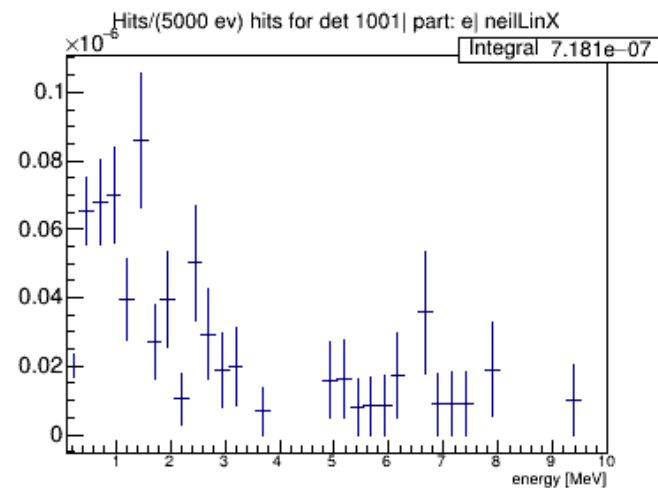
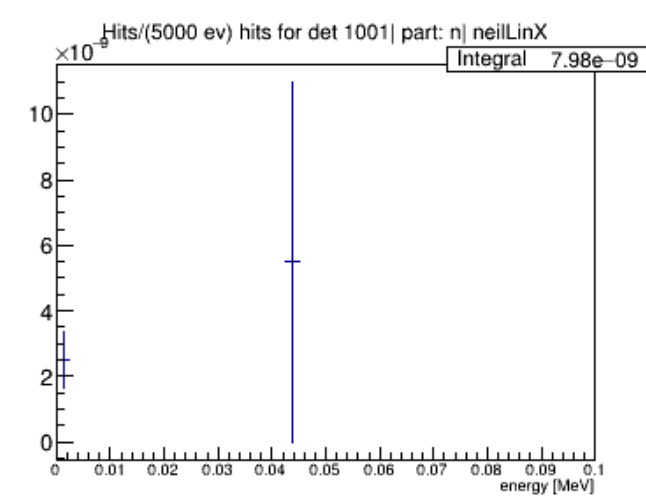
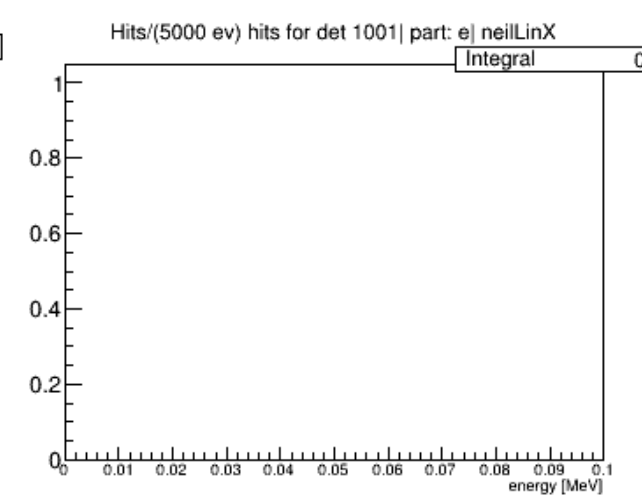
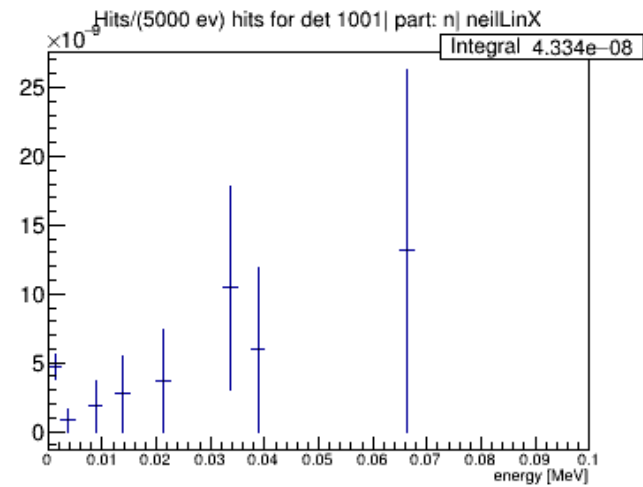
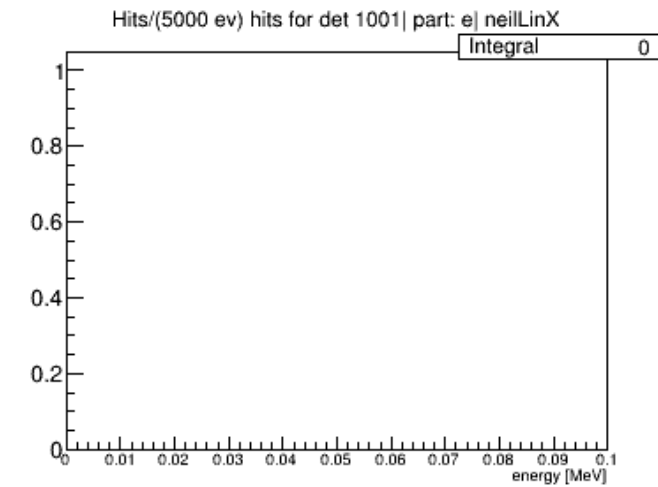
## current setup





# CREX - comparison

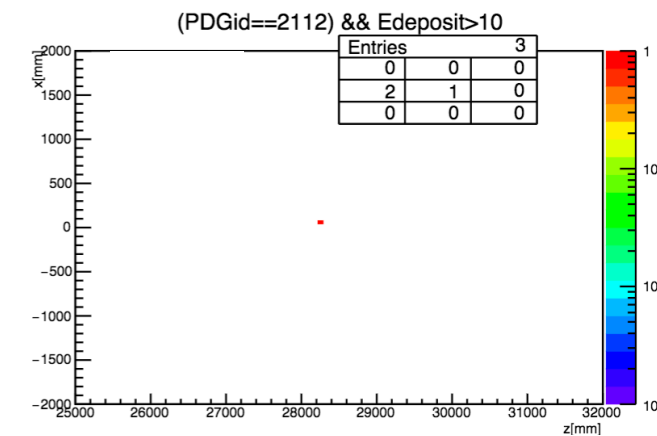
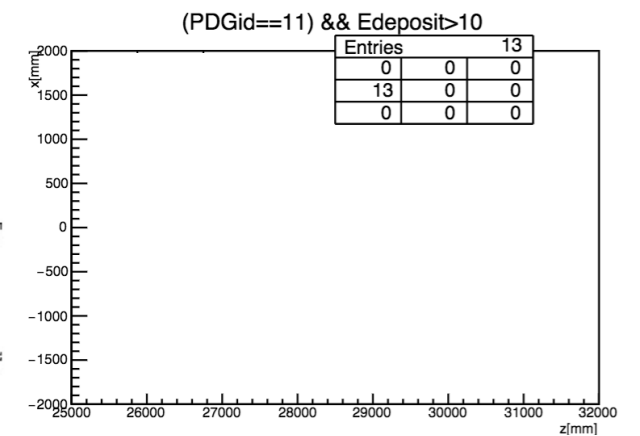
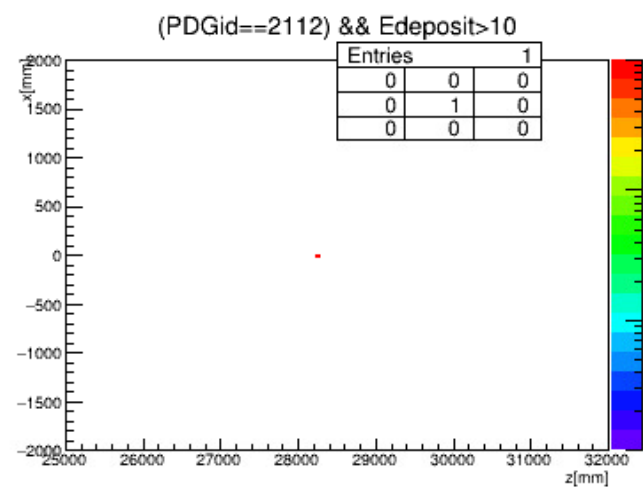
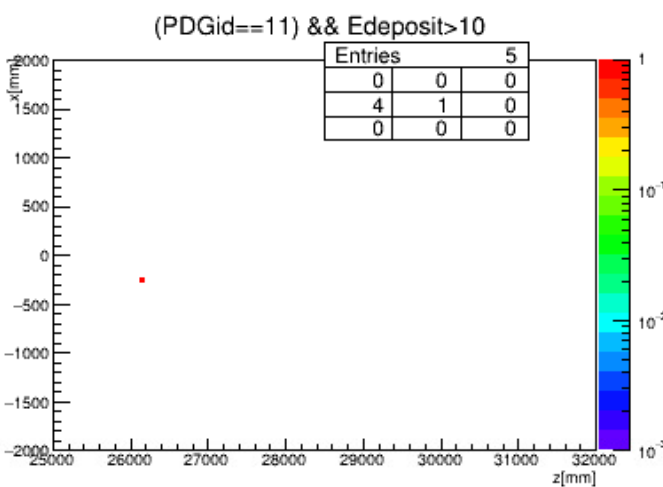
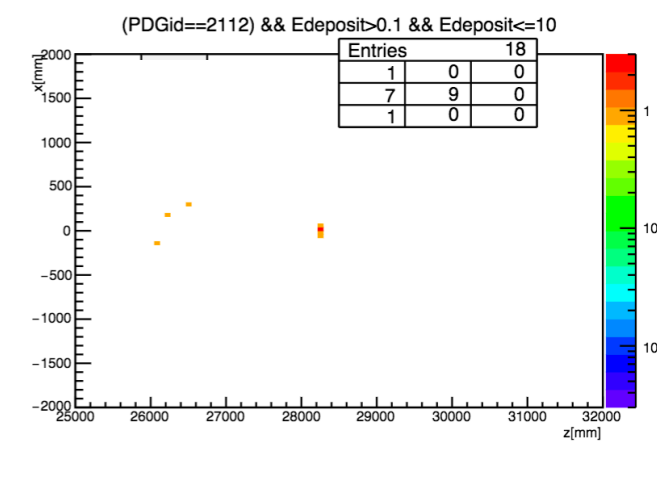
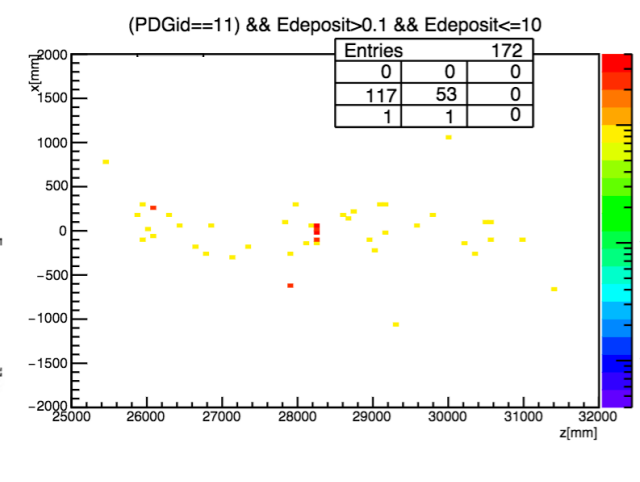
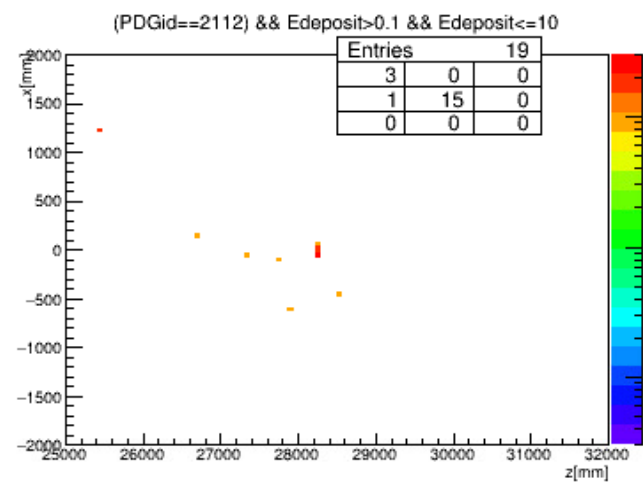
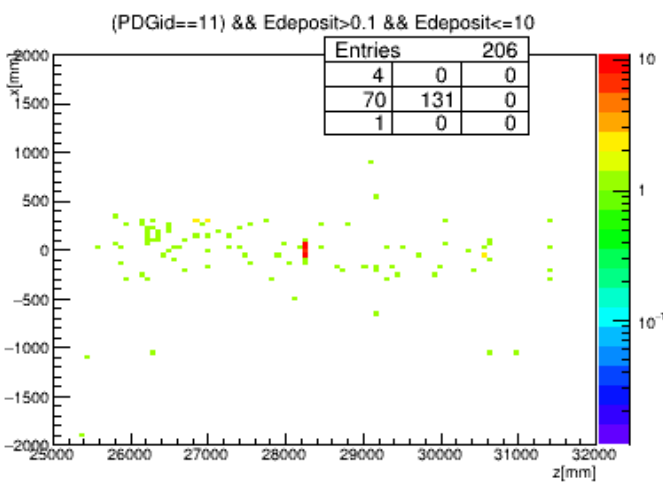
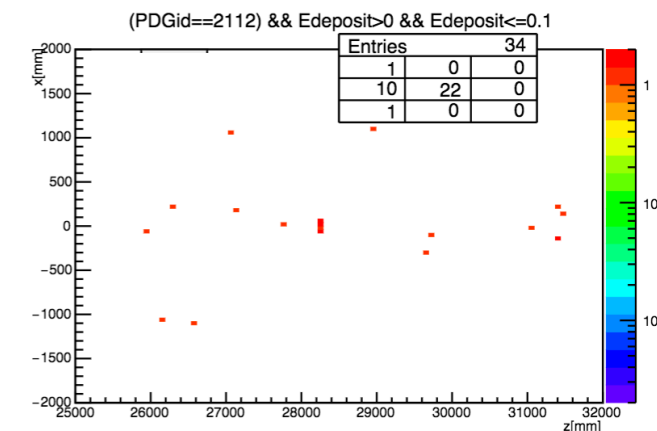
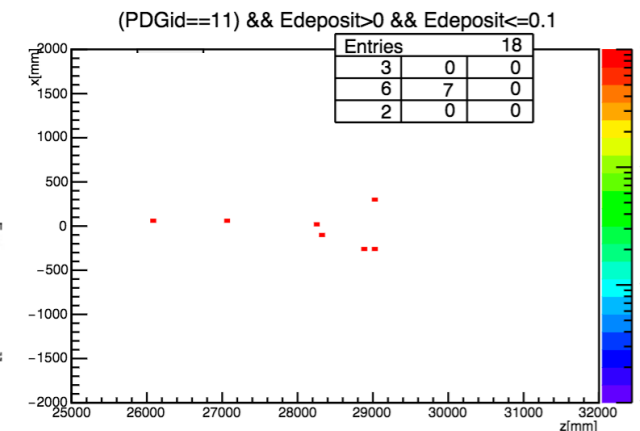
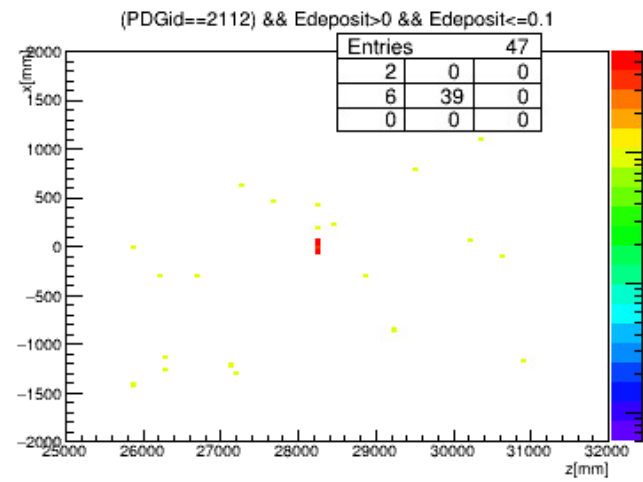
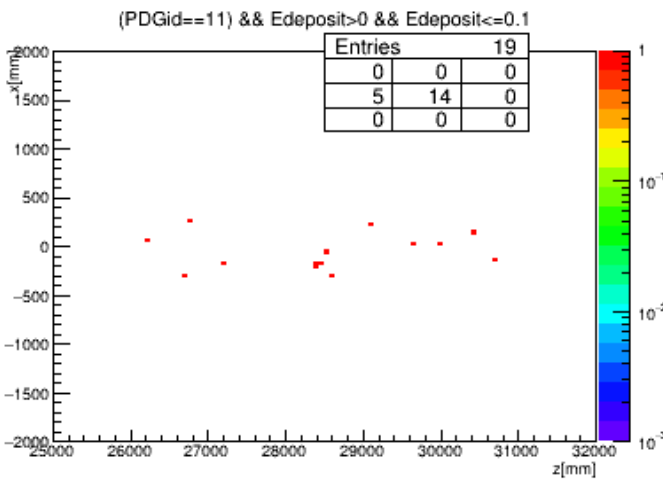
## current setup



## current setup + 1 ft concrete shield

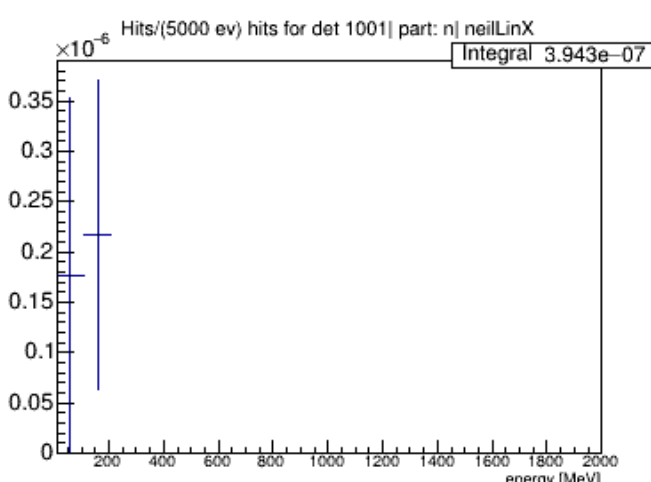
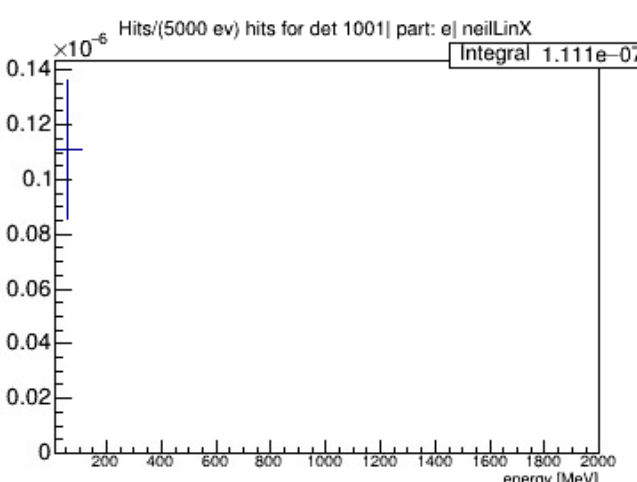
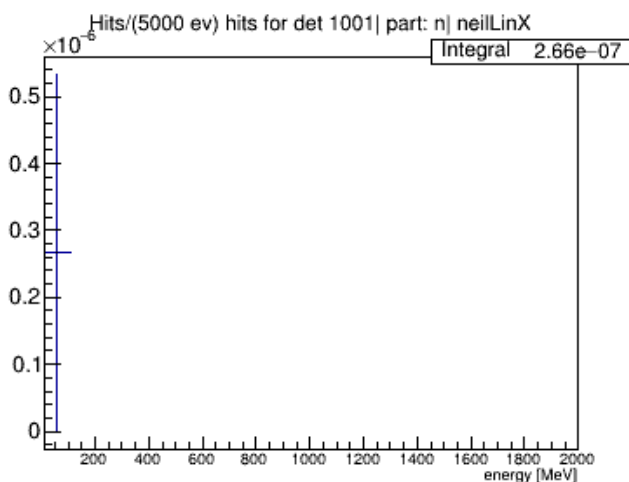
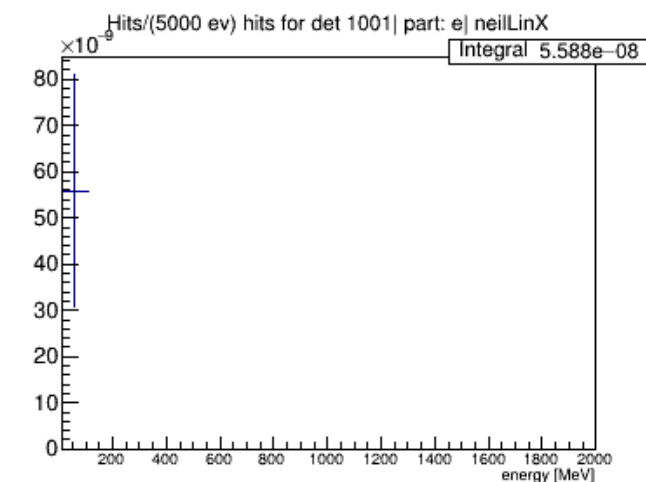
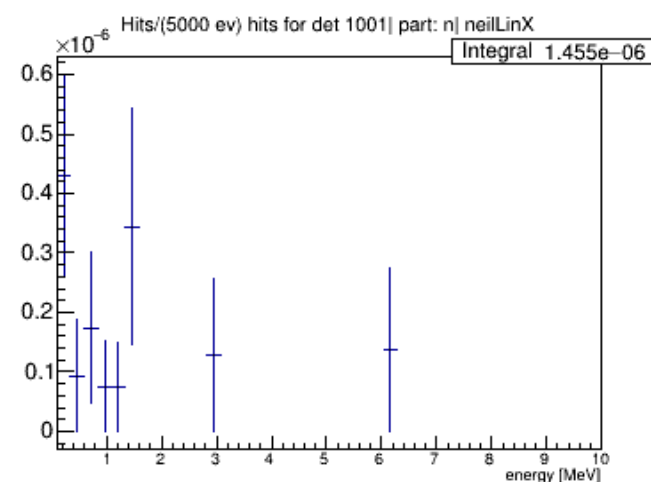
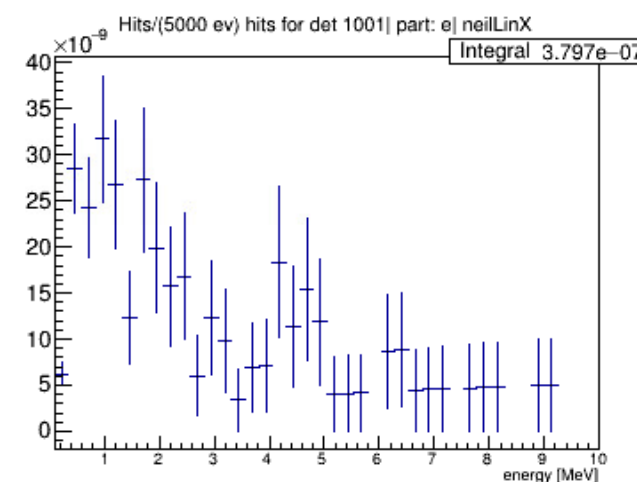
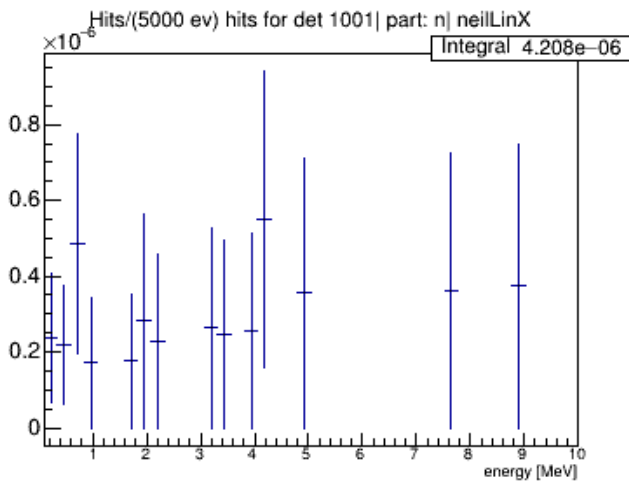
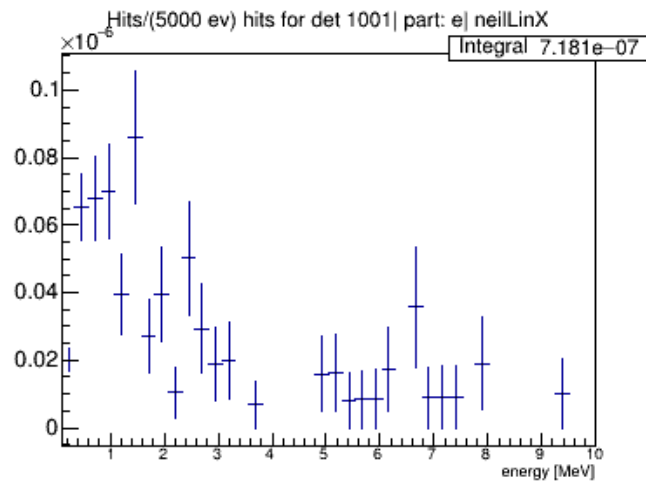
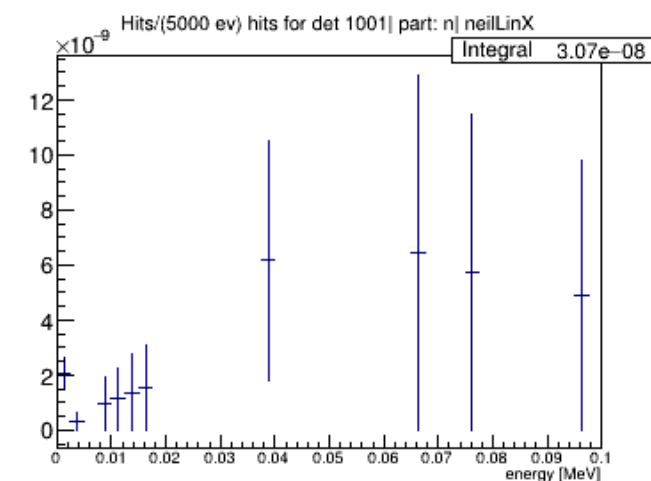
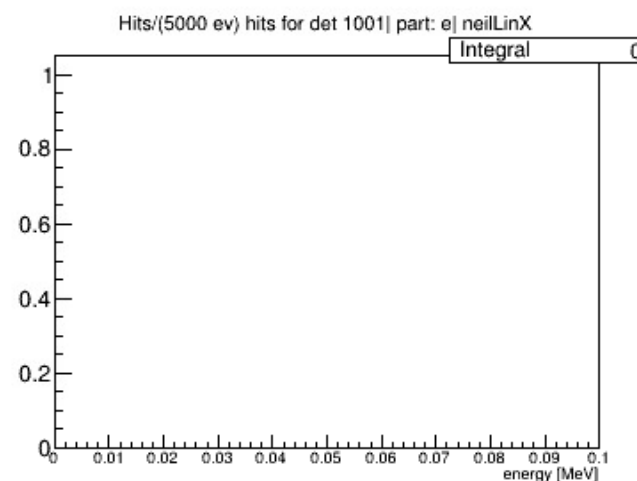
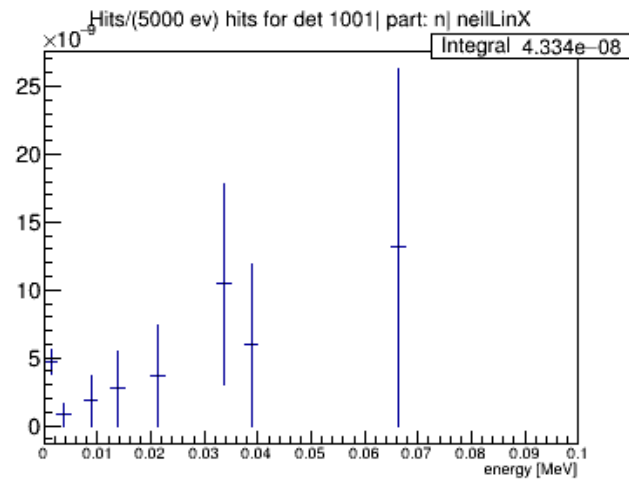
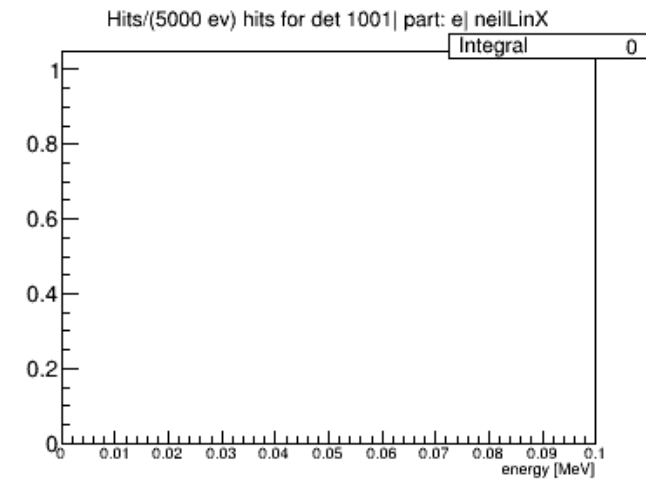
# CREX - comparison

## current setup



# CREX - comparison

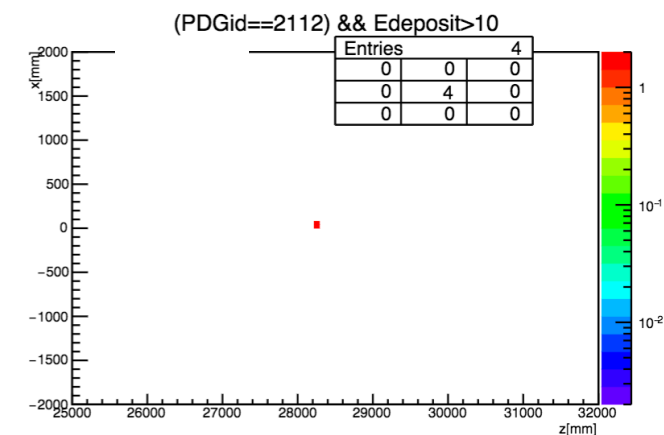
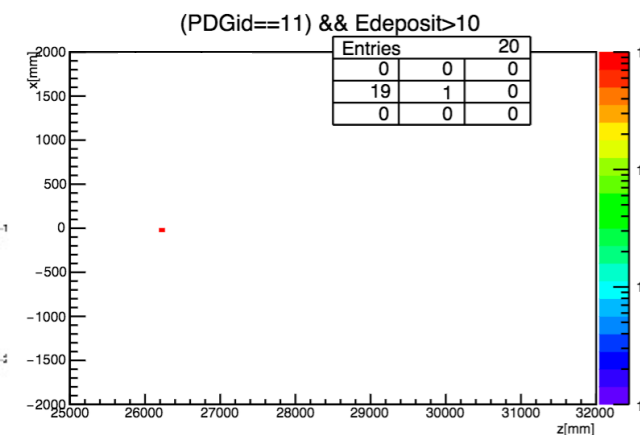
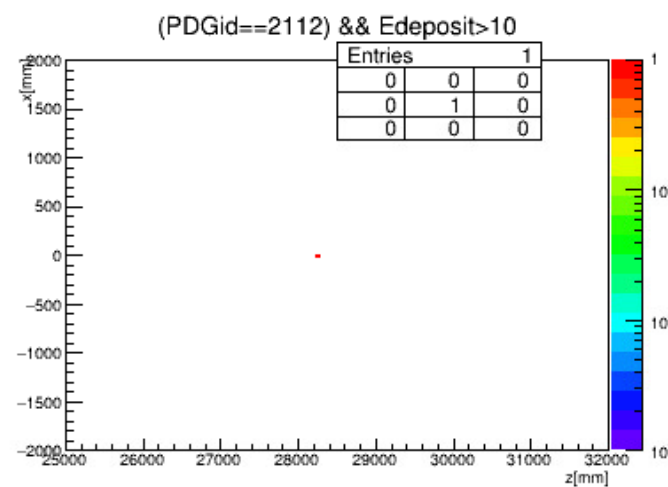
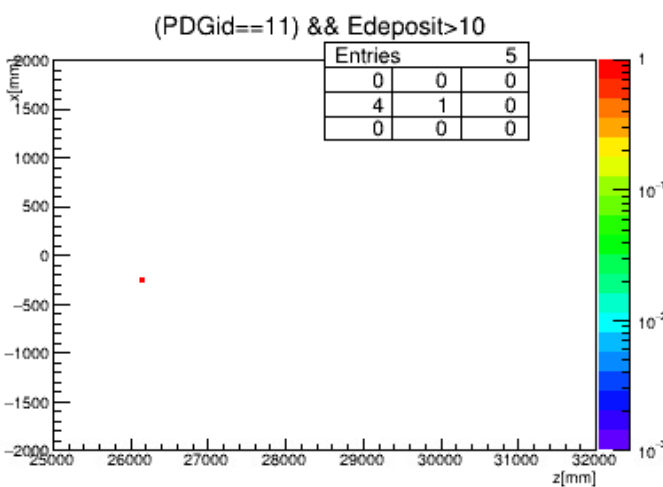
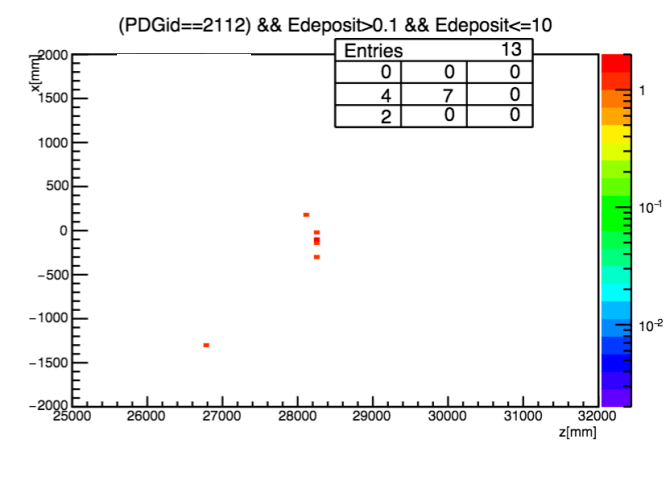
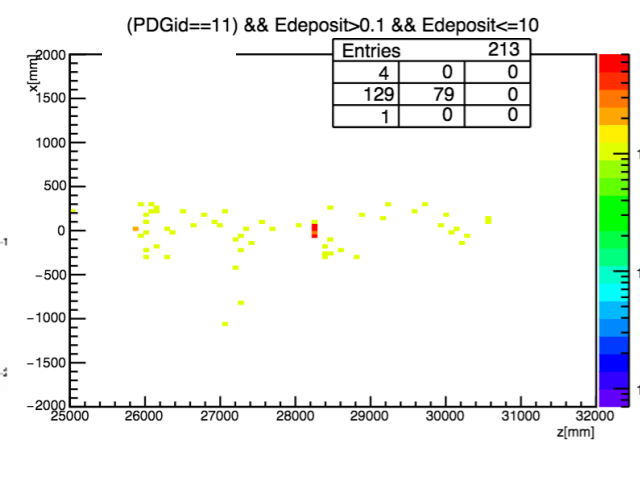
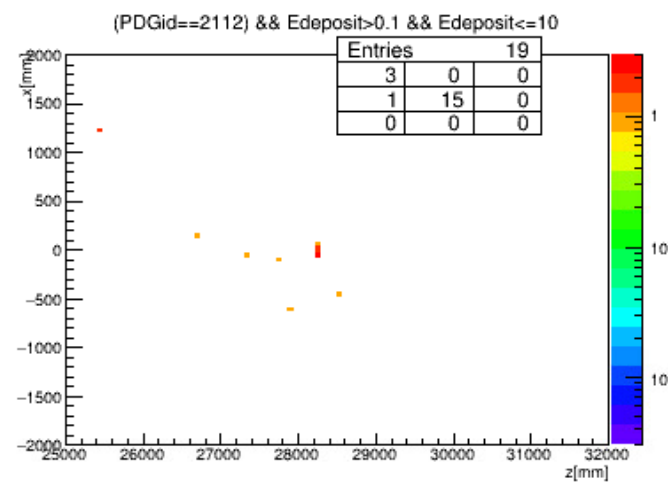
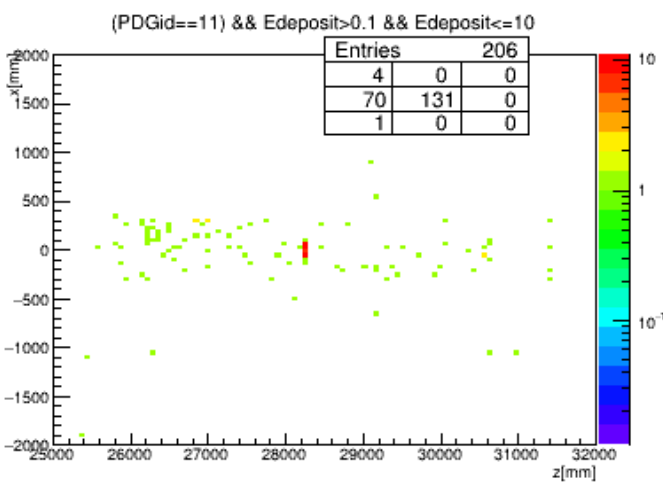
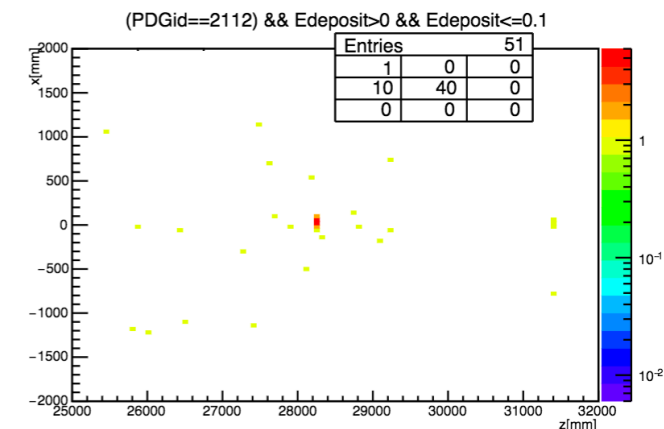
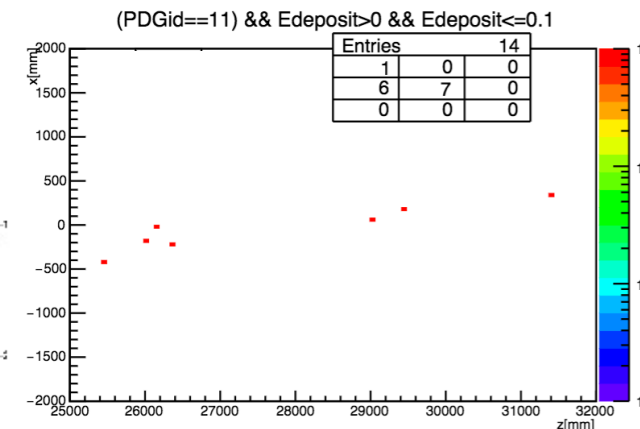
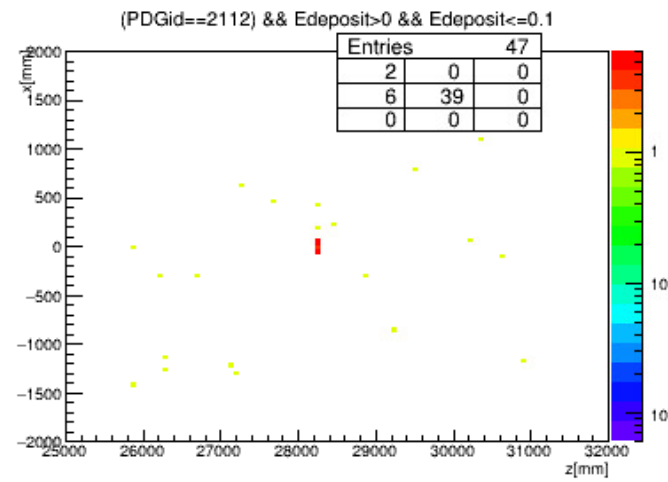
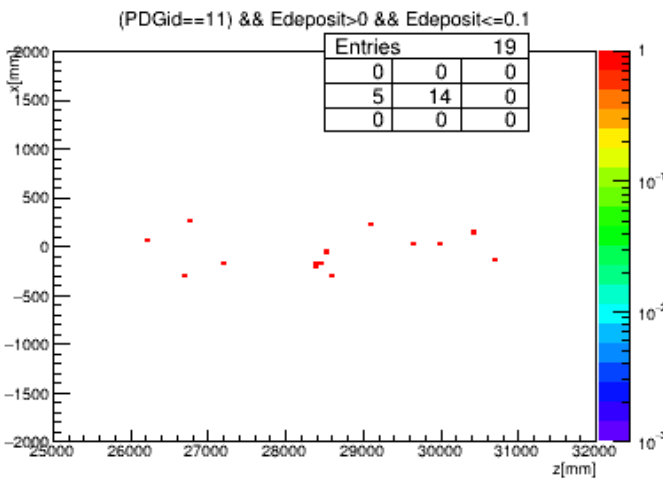
## current setup



## current setup + 2 ft concrete shield

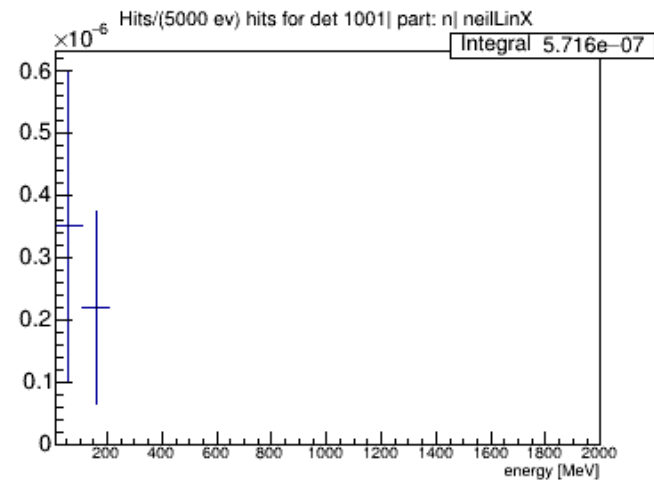
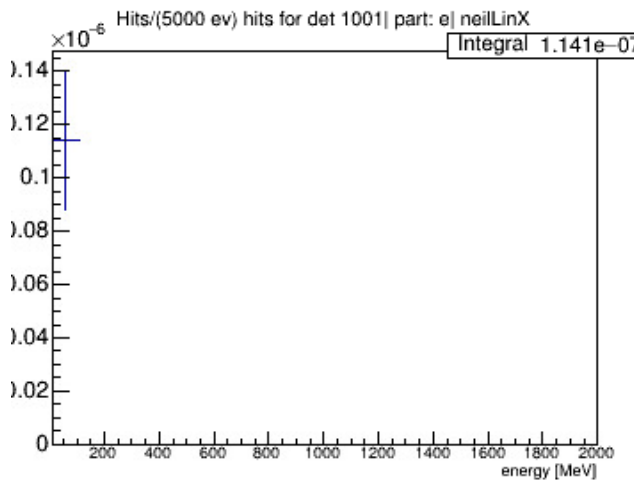
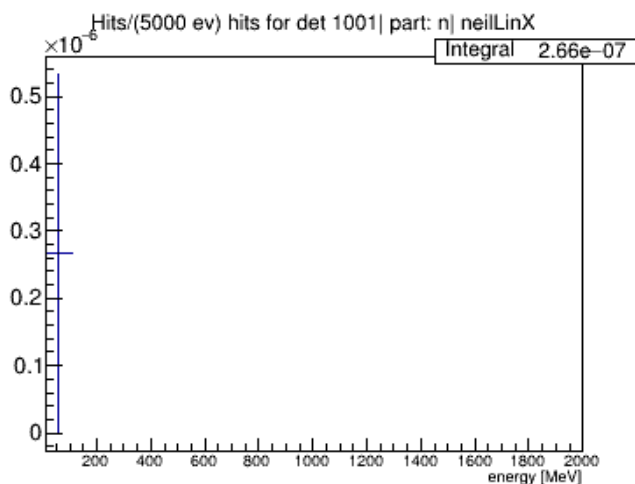
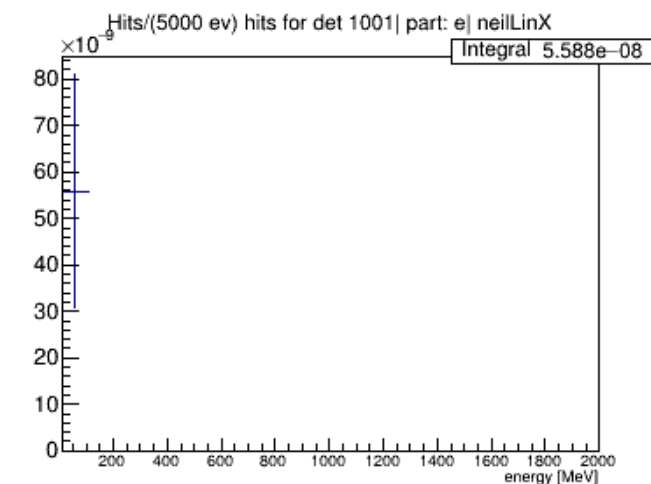
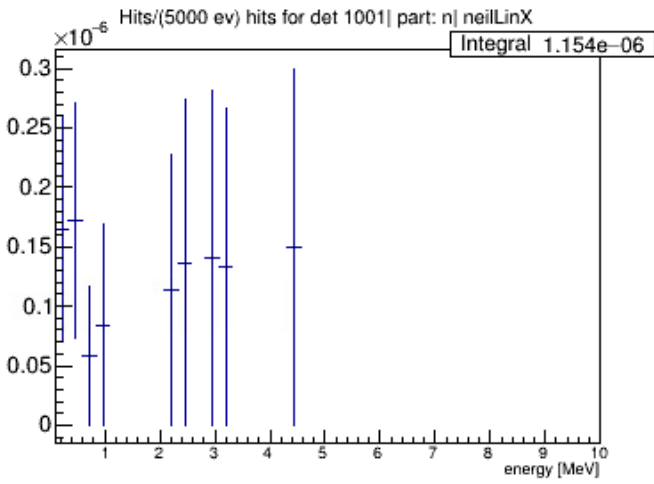
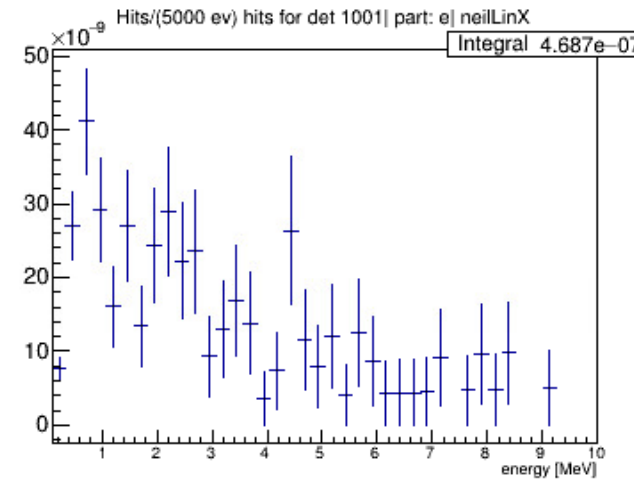
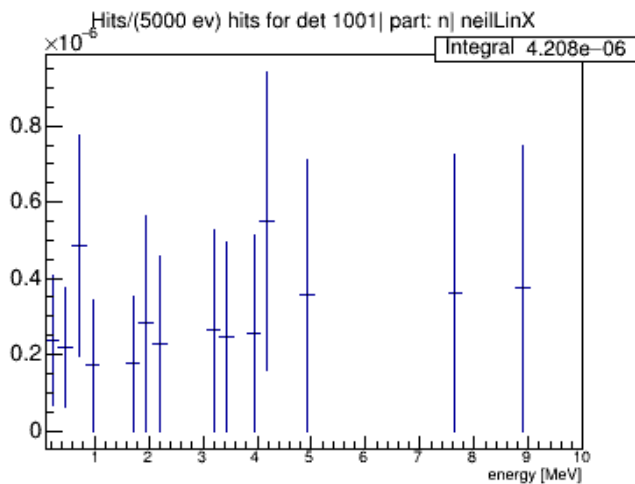
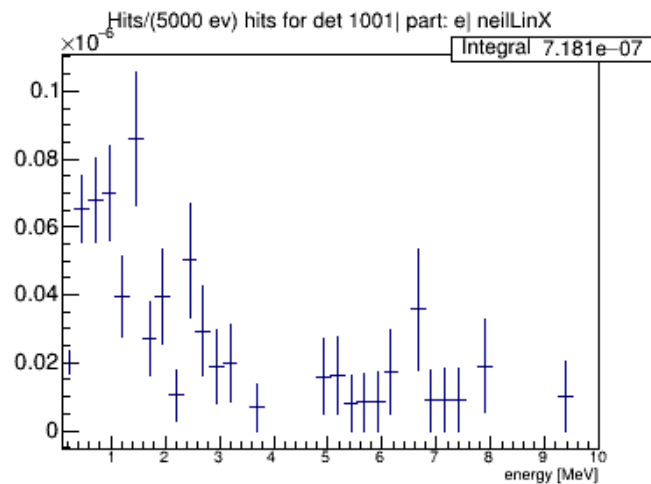
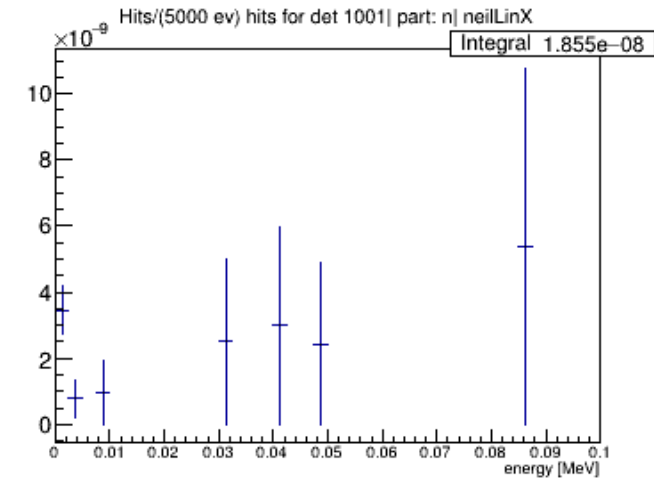
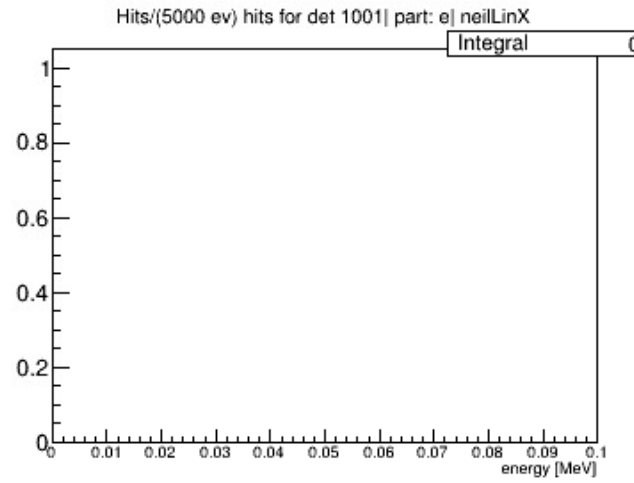
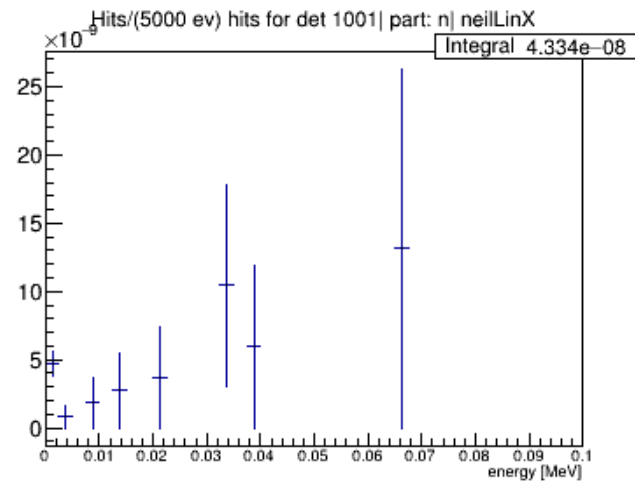
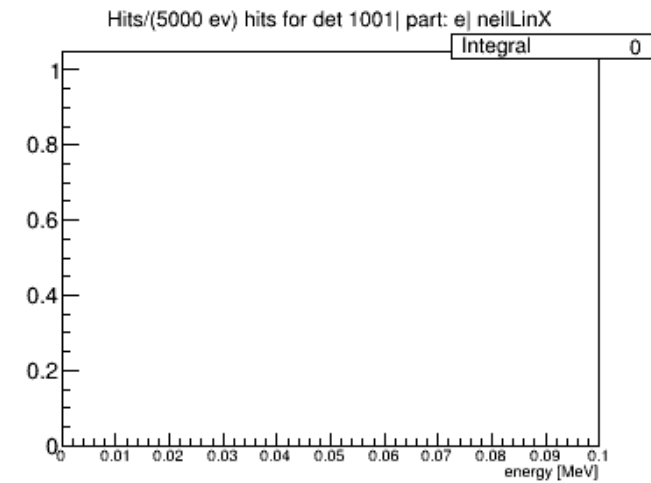
# CREX - comparison

## current setup



# CREX - comparison

## current setup



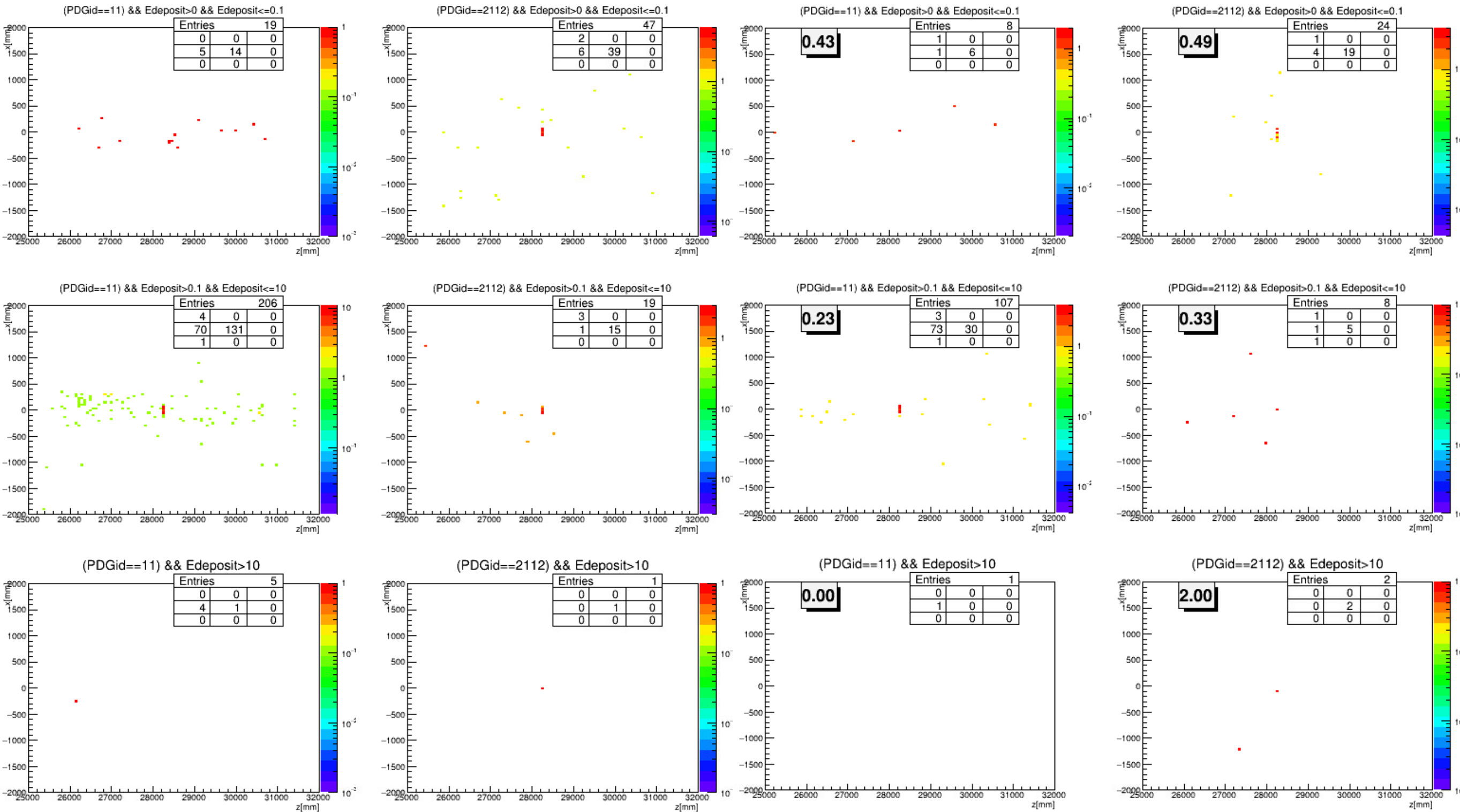
## current setup + 0.5 ft concrete shield



# CREX - comparison

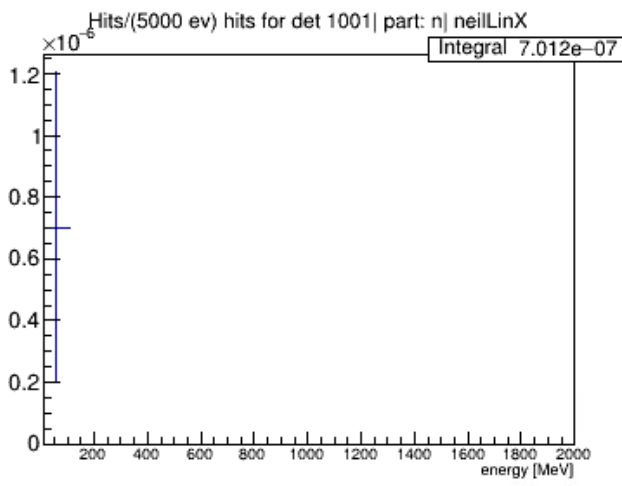
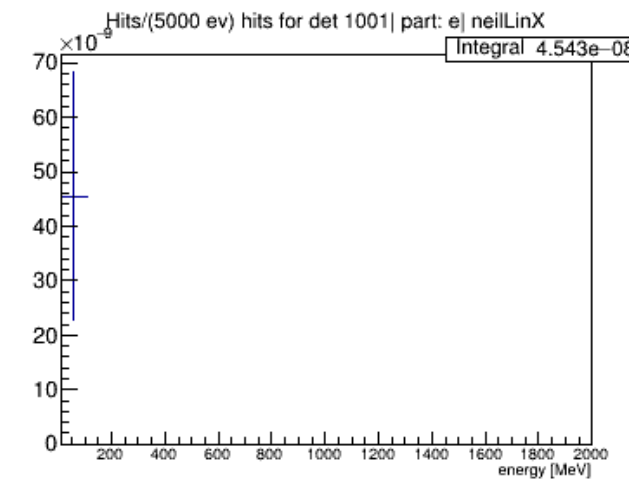
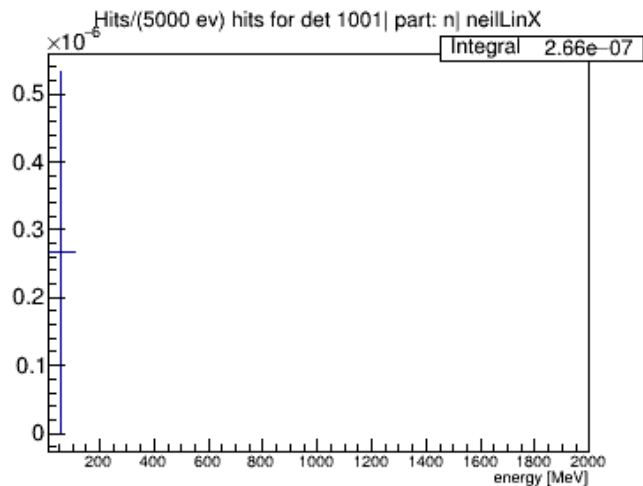
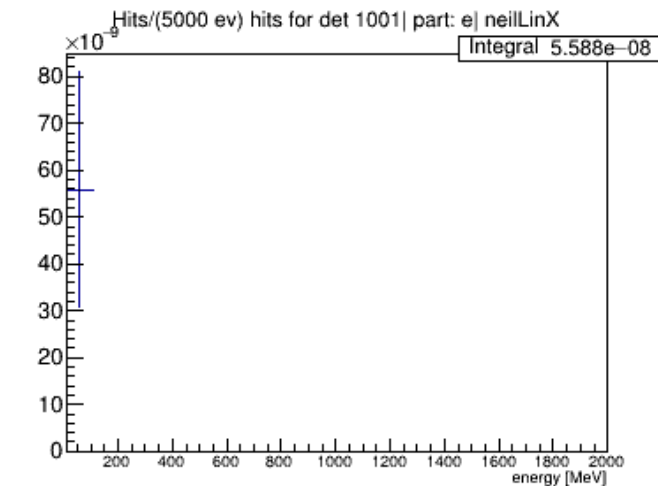
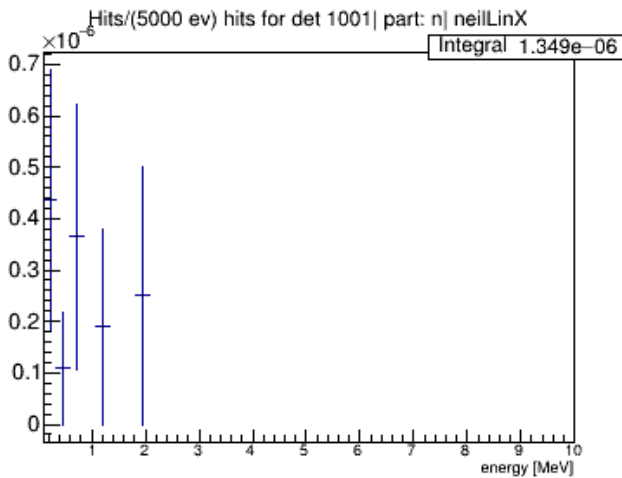
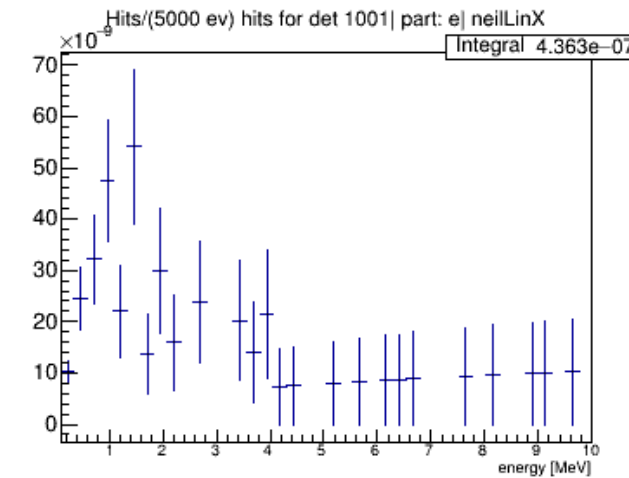
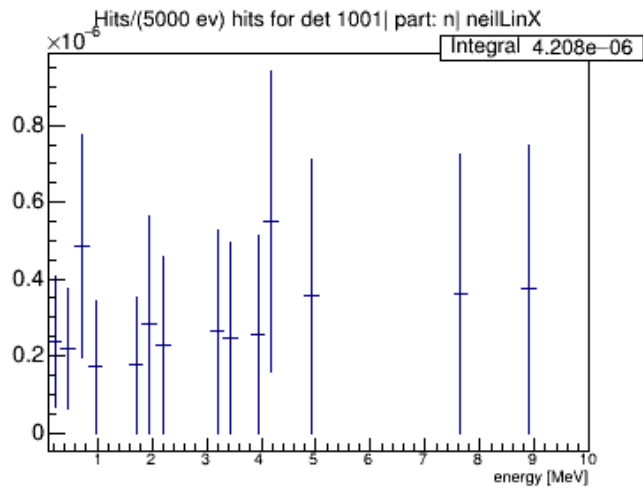
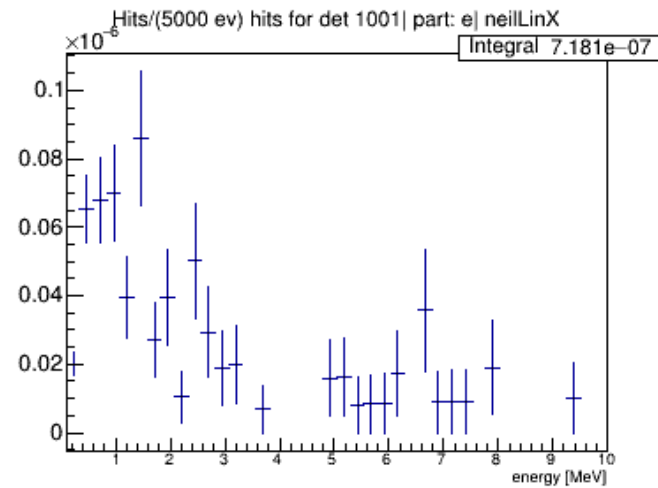
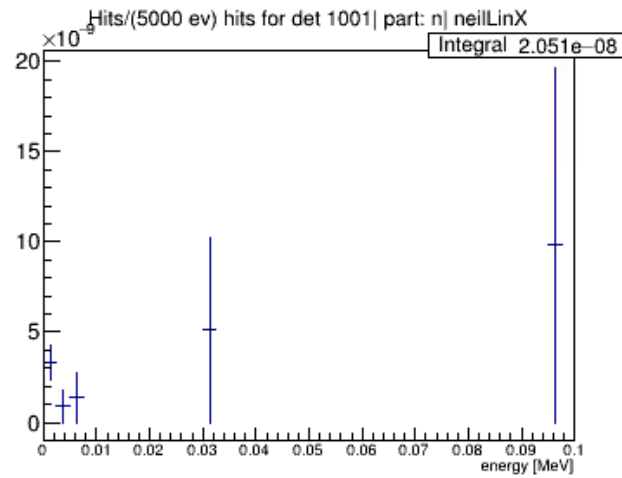
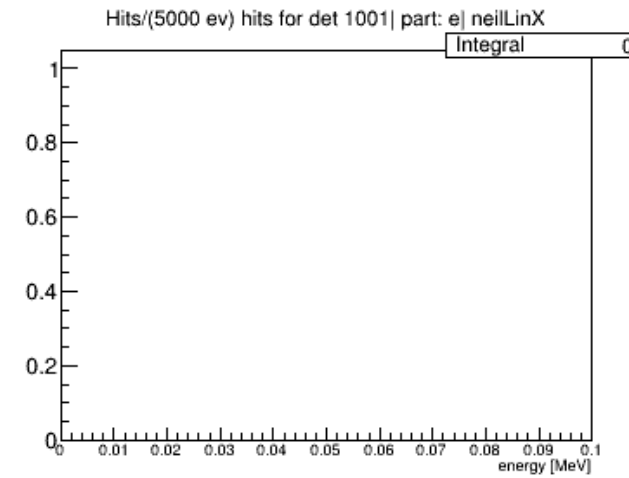
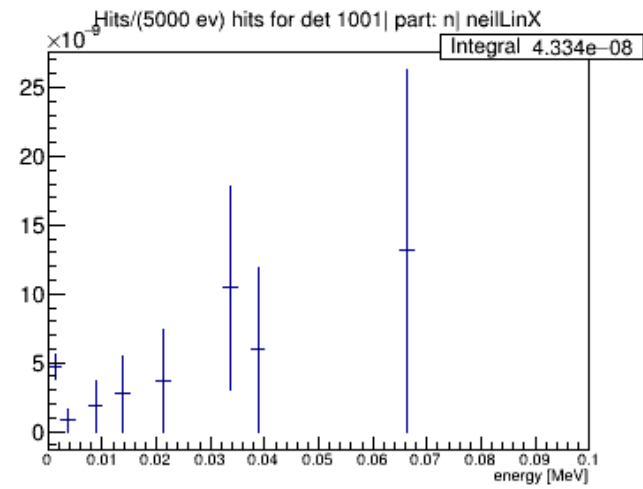
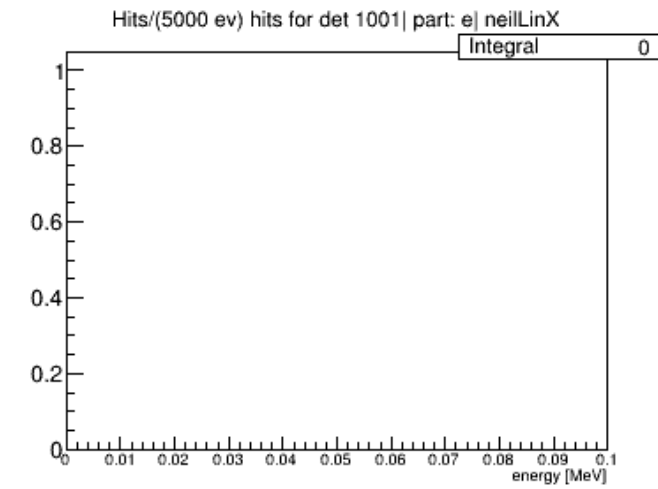
current setup

current setup + 1 ft Poly shield



# CREX - comparison

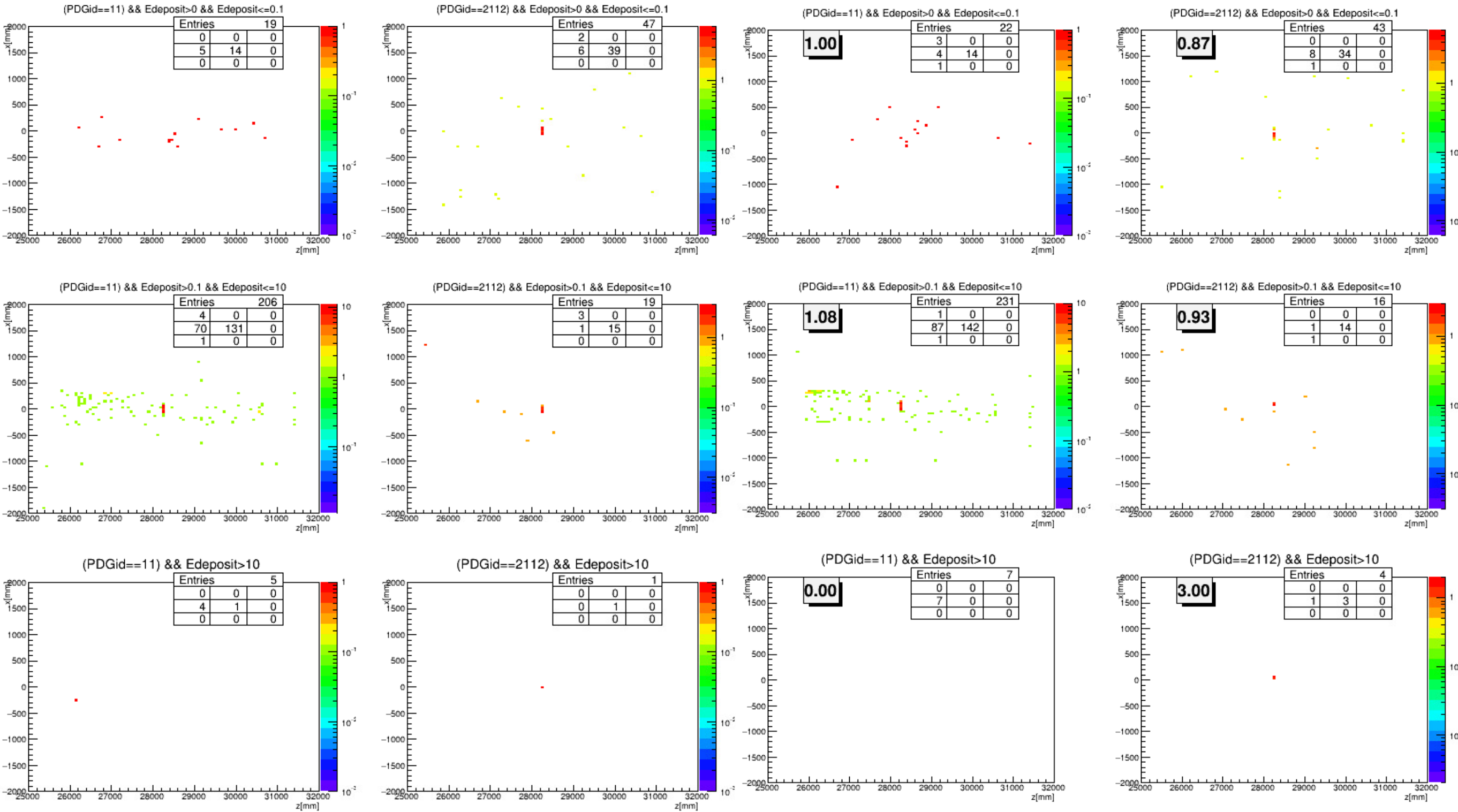
## current setup



# CREX - comparison

current setup

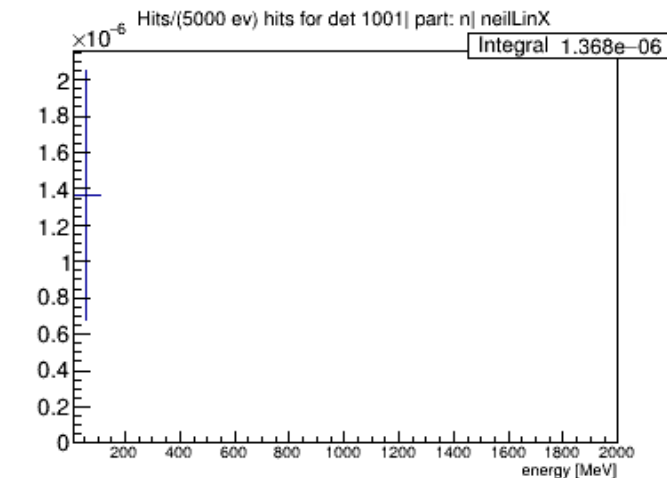
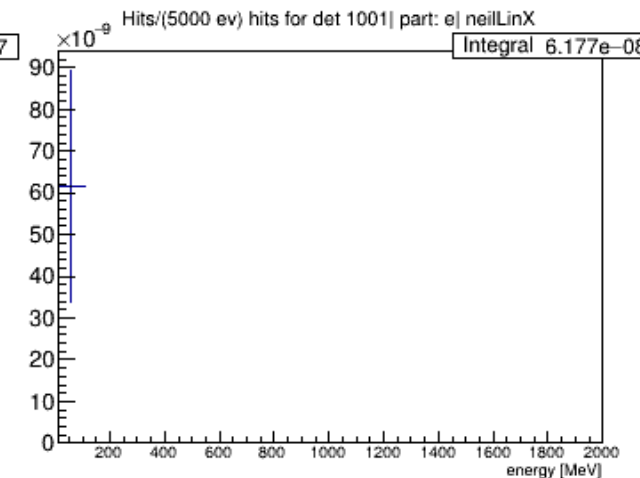
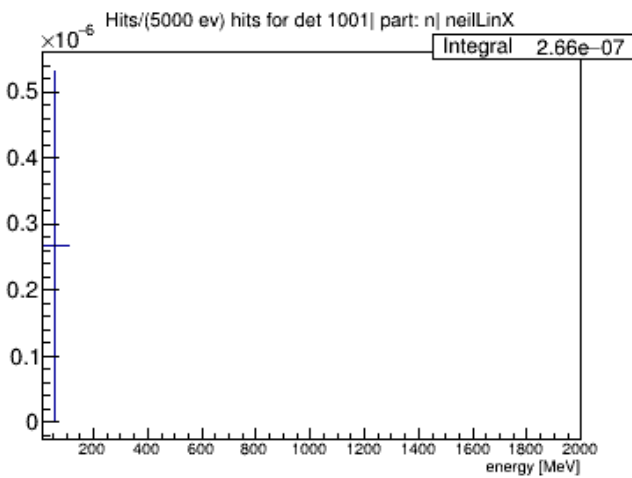
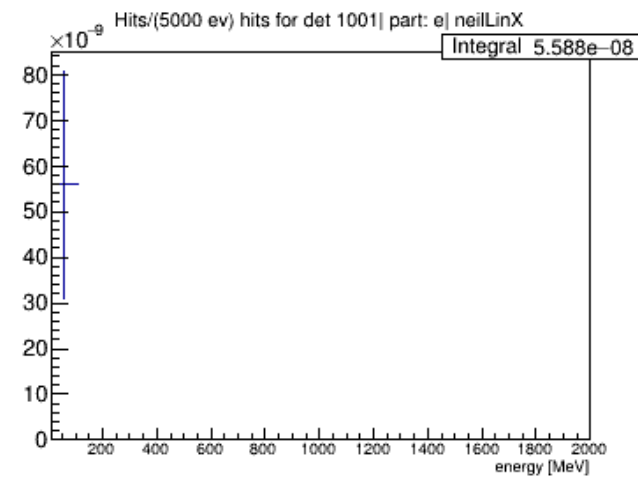
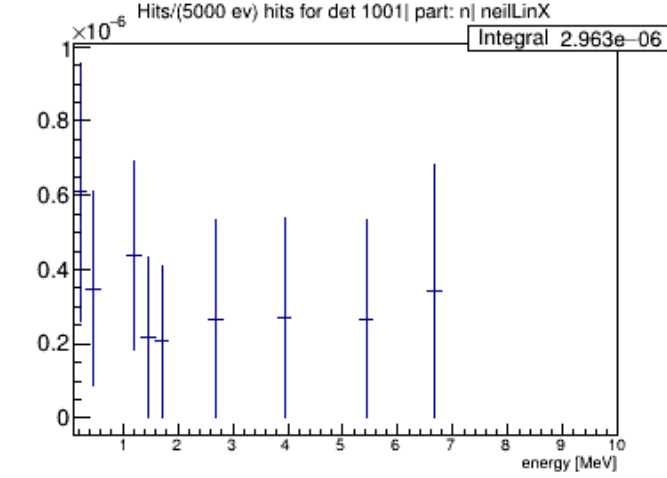
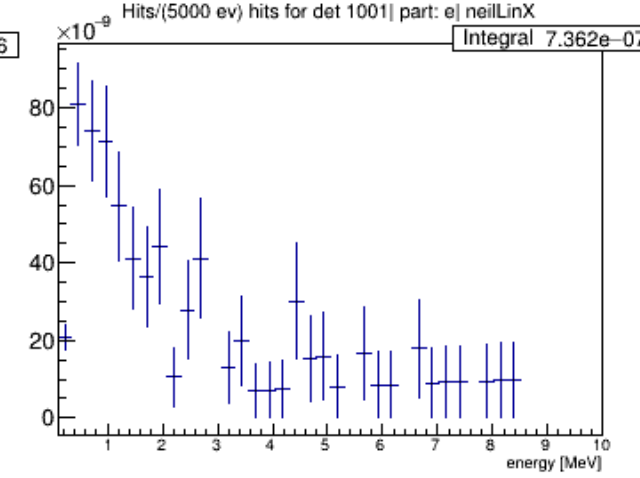
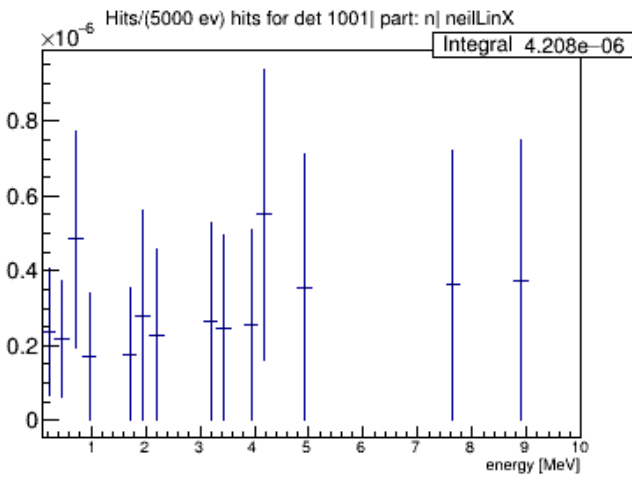
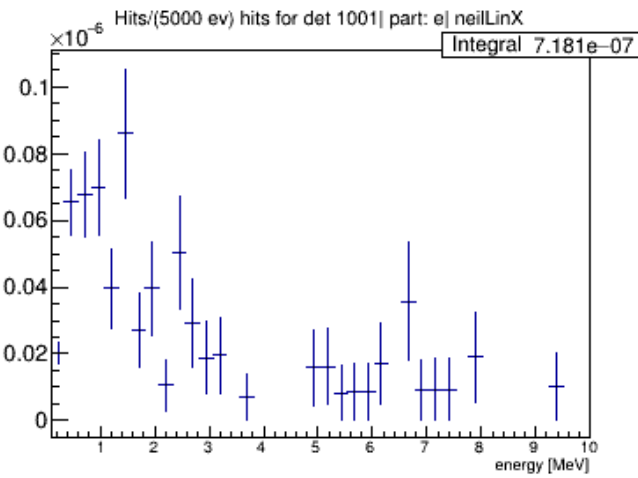
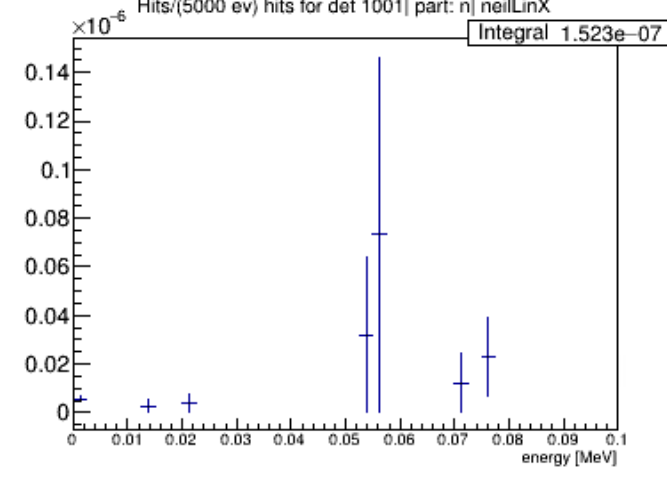
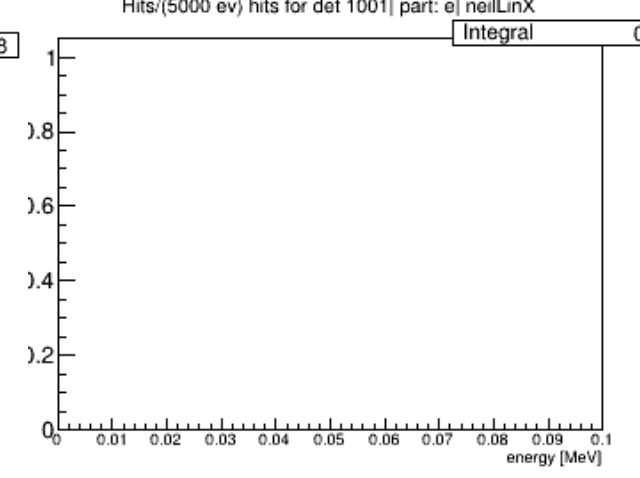
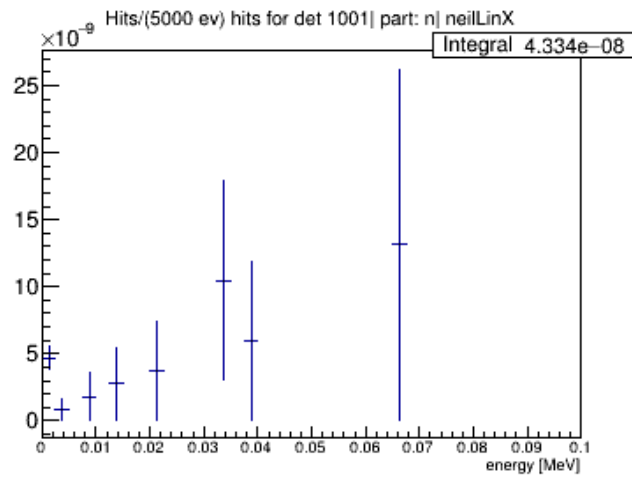
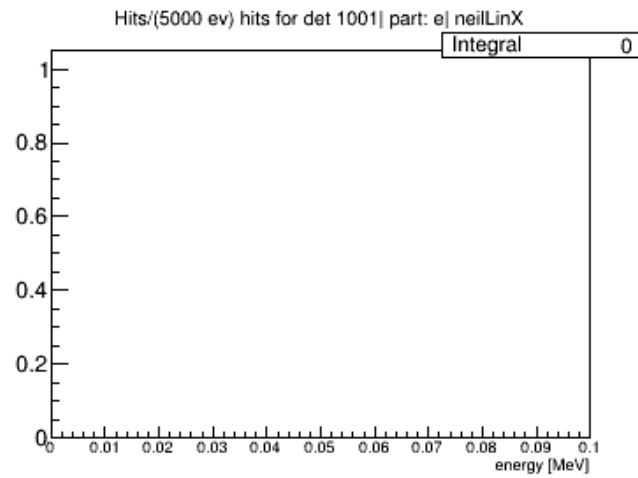
current setup + 2PipeSeptum



# CREX - comparison

current setup

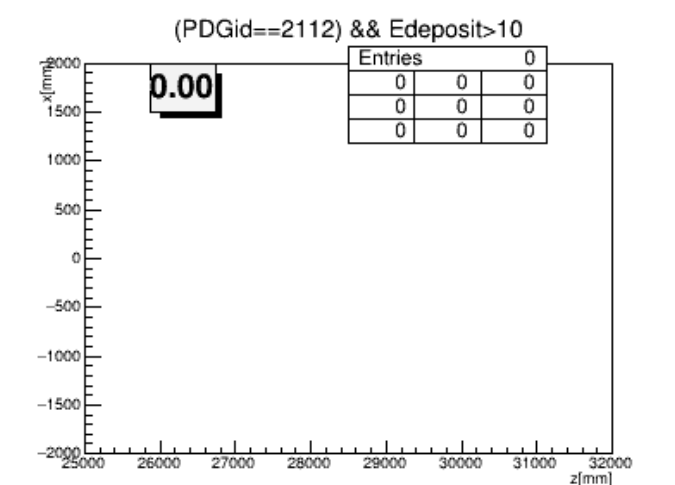
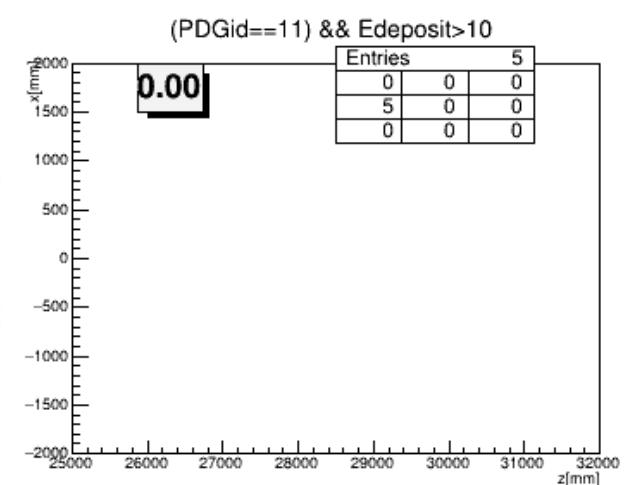
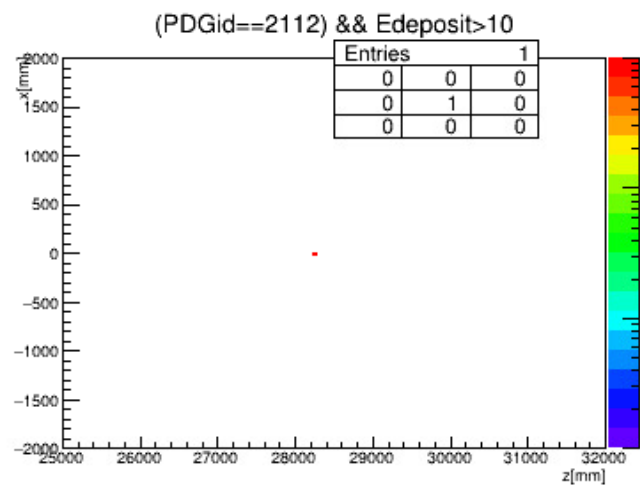
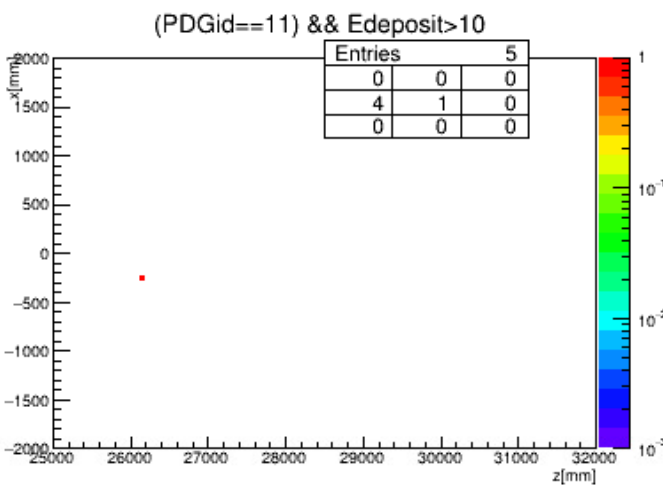
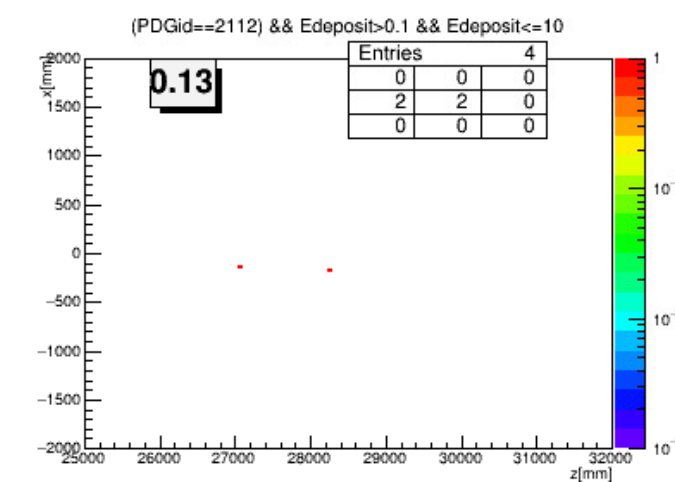
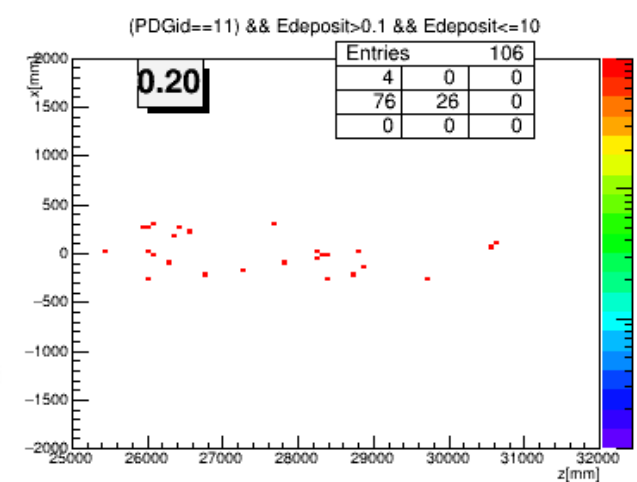
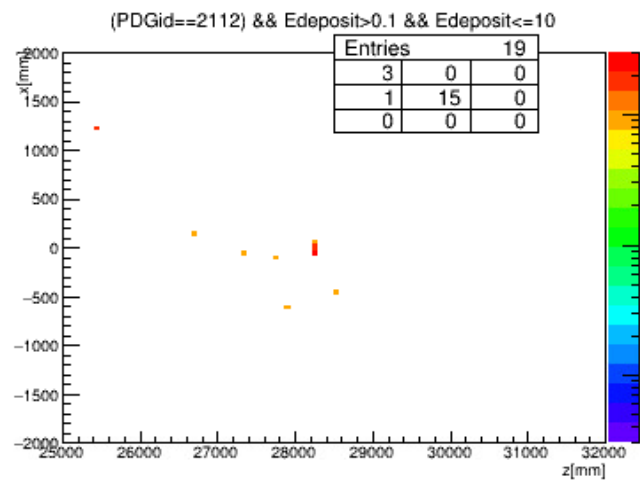
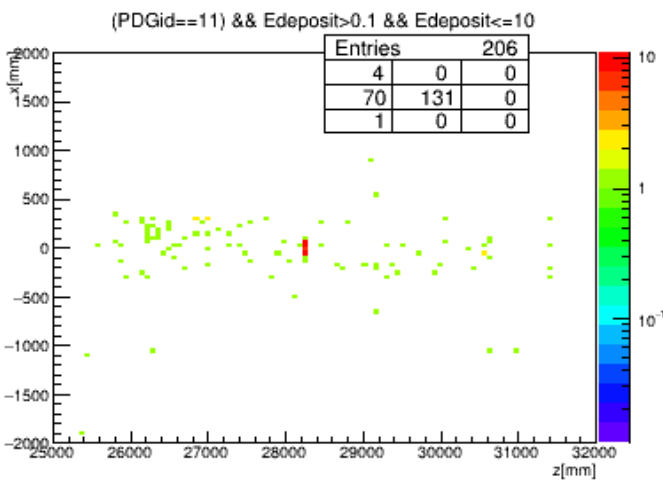
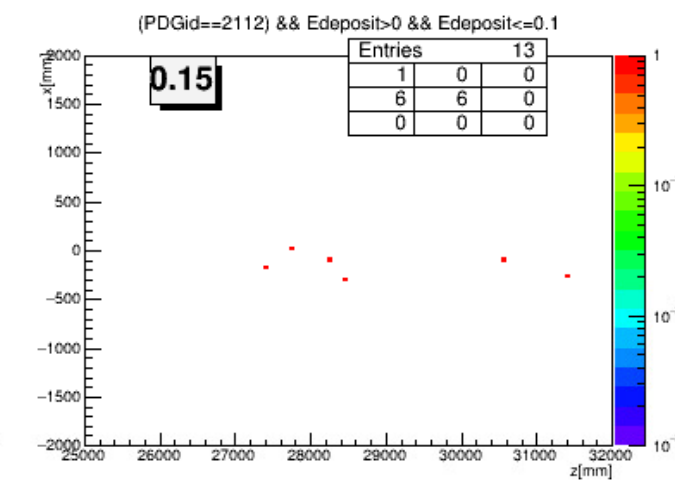
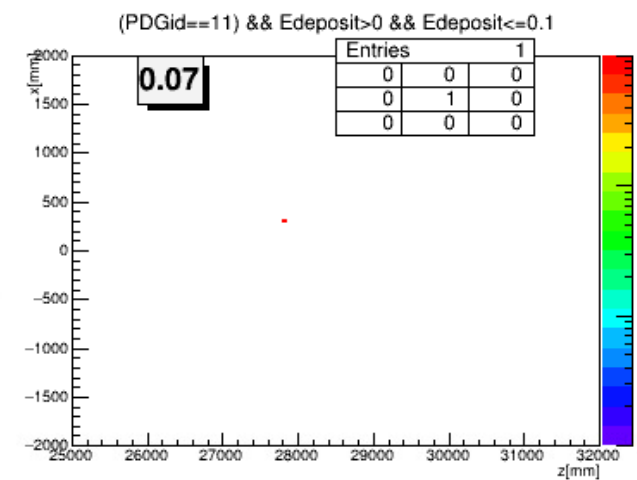
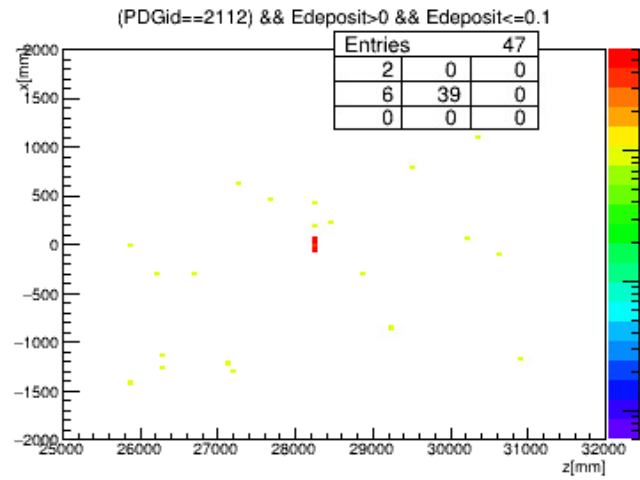
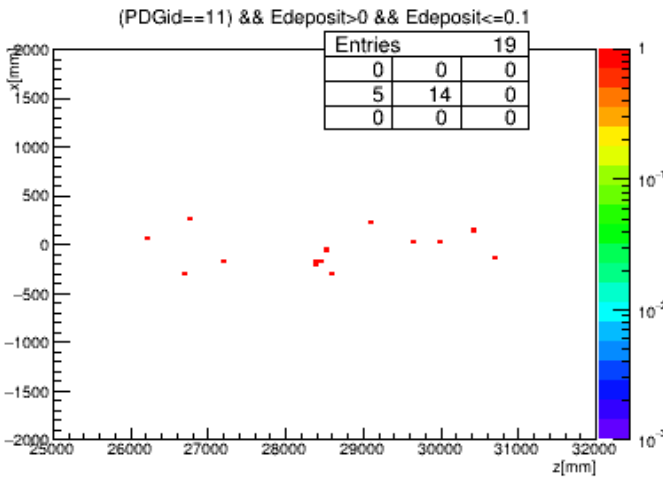
current setup + 2PipeSeptum





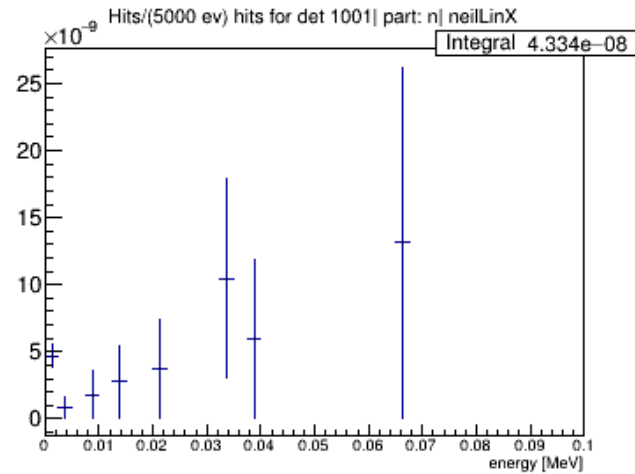
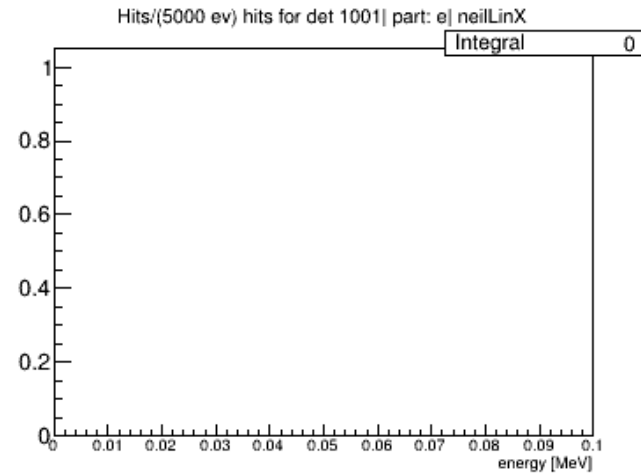
# CREX - comparison

## current setup

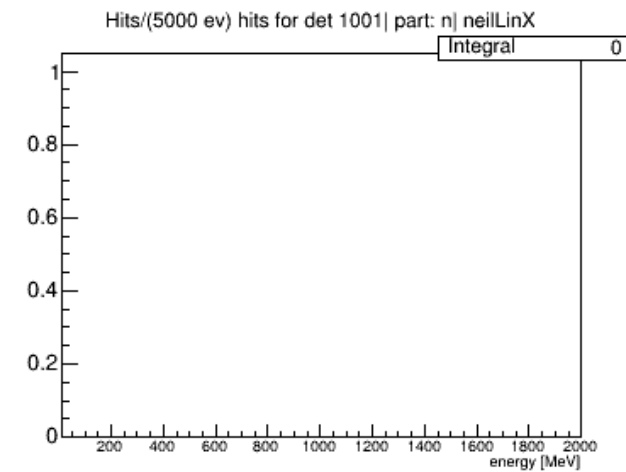
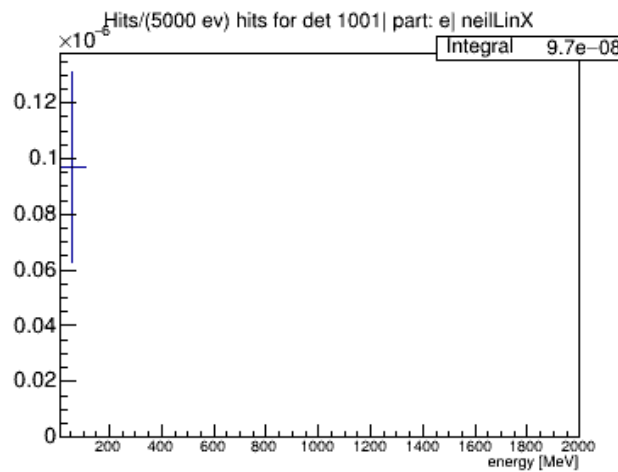
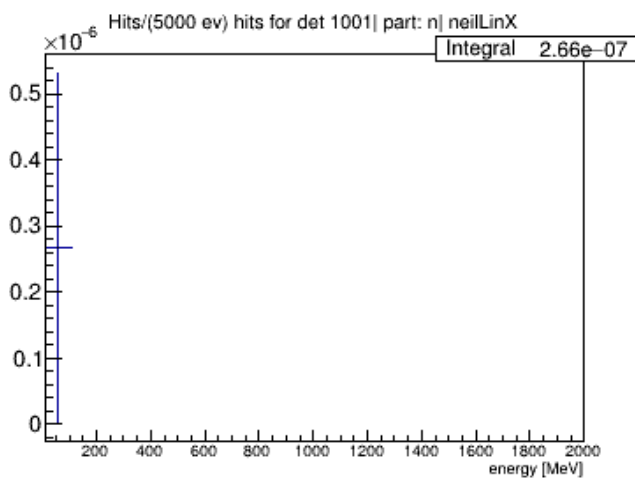
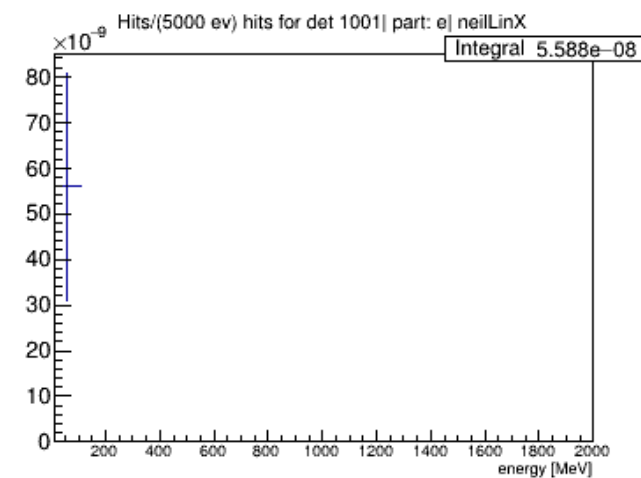
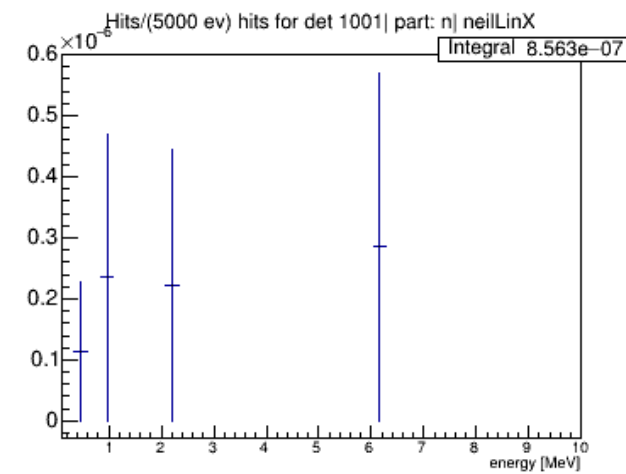
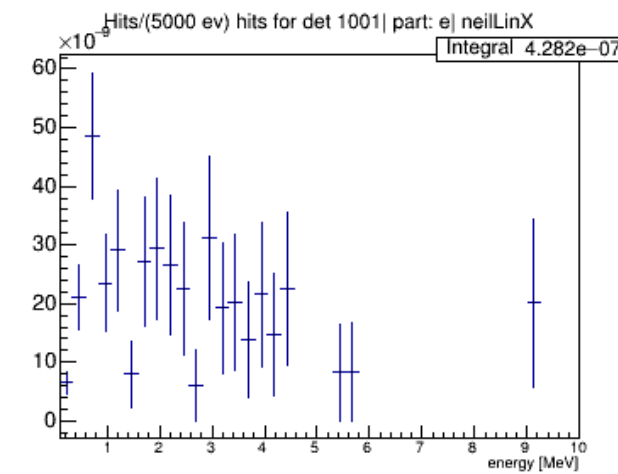
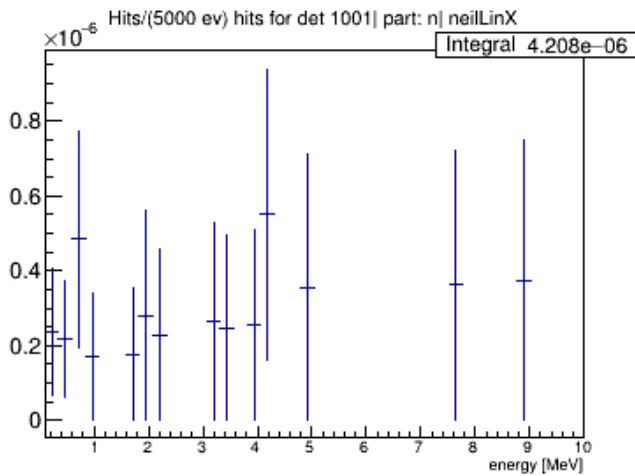
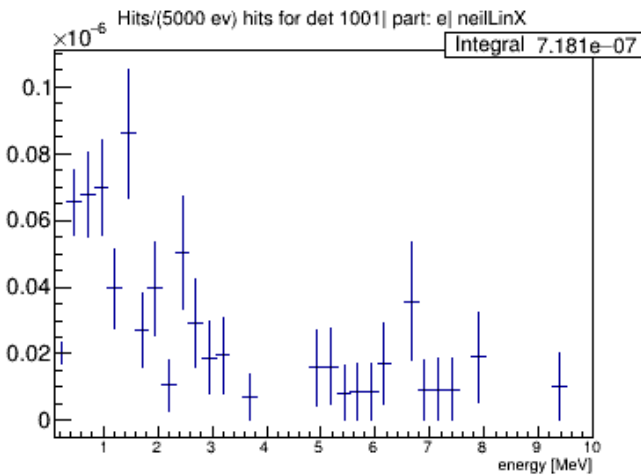
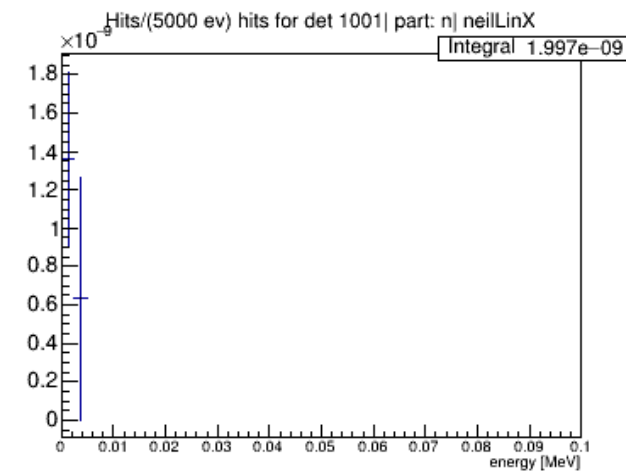
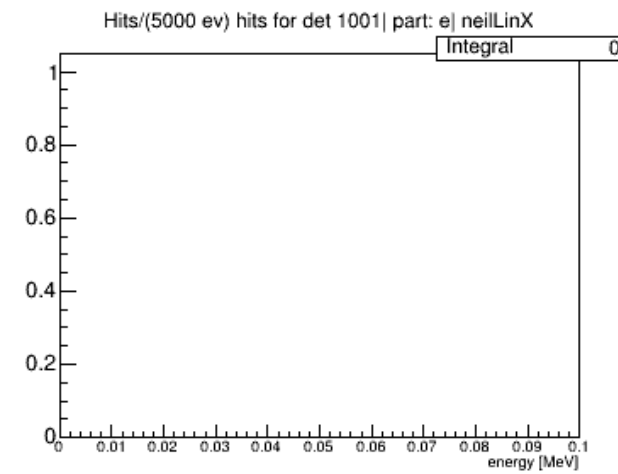


# CREX - comparison

## current setup



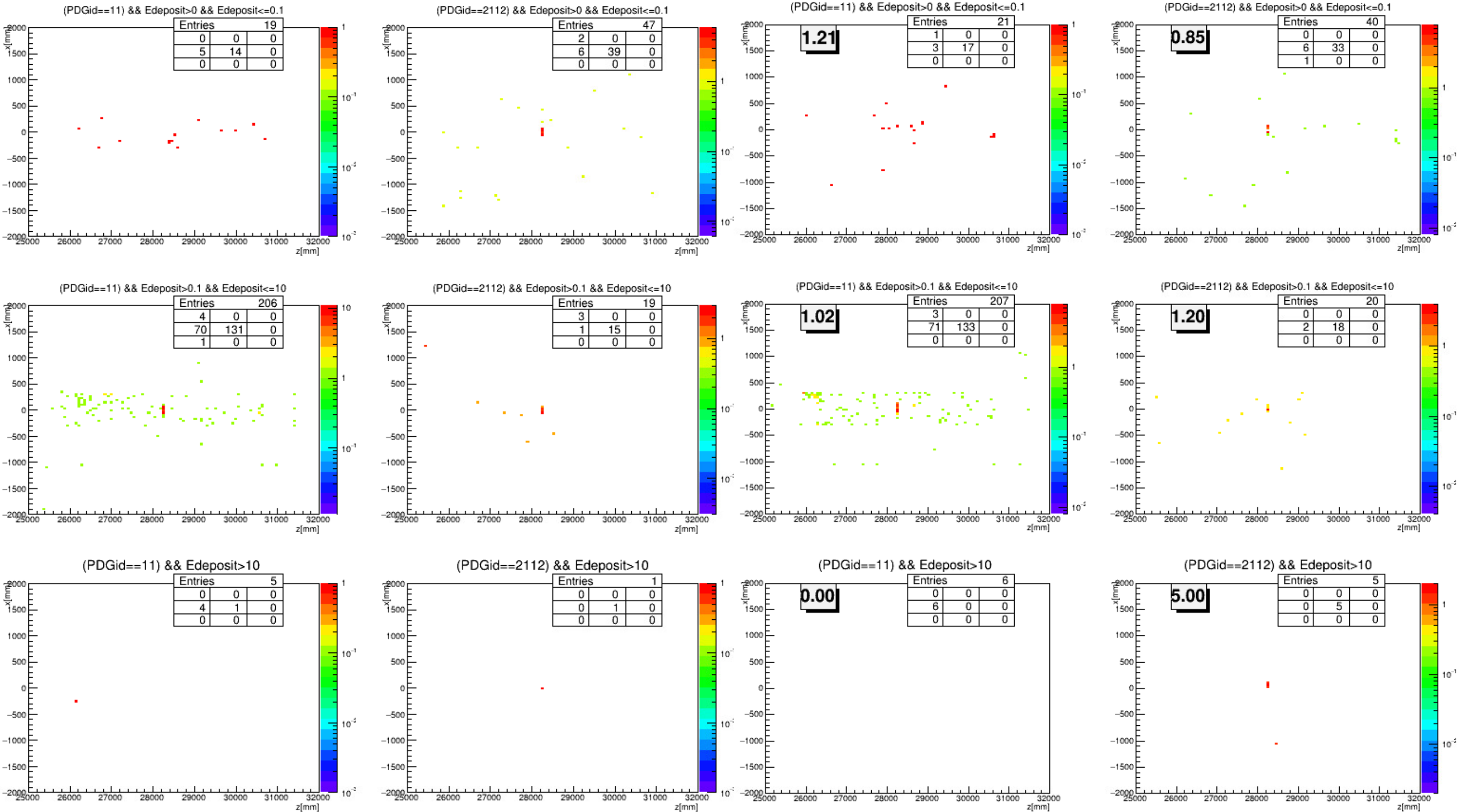
## current setup + 4 in Donut+ 1 ft concrete shield



# CREX - comparison

current setup + 2PipeSeptum+donut shield

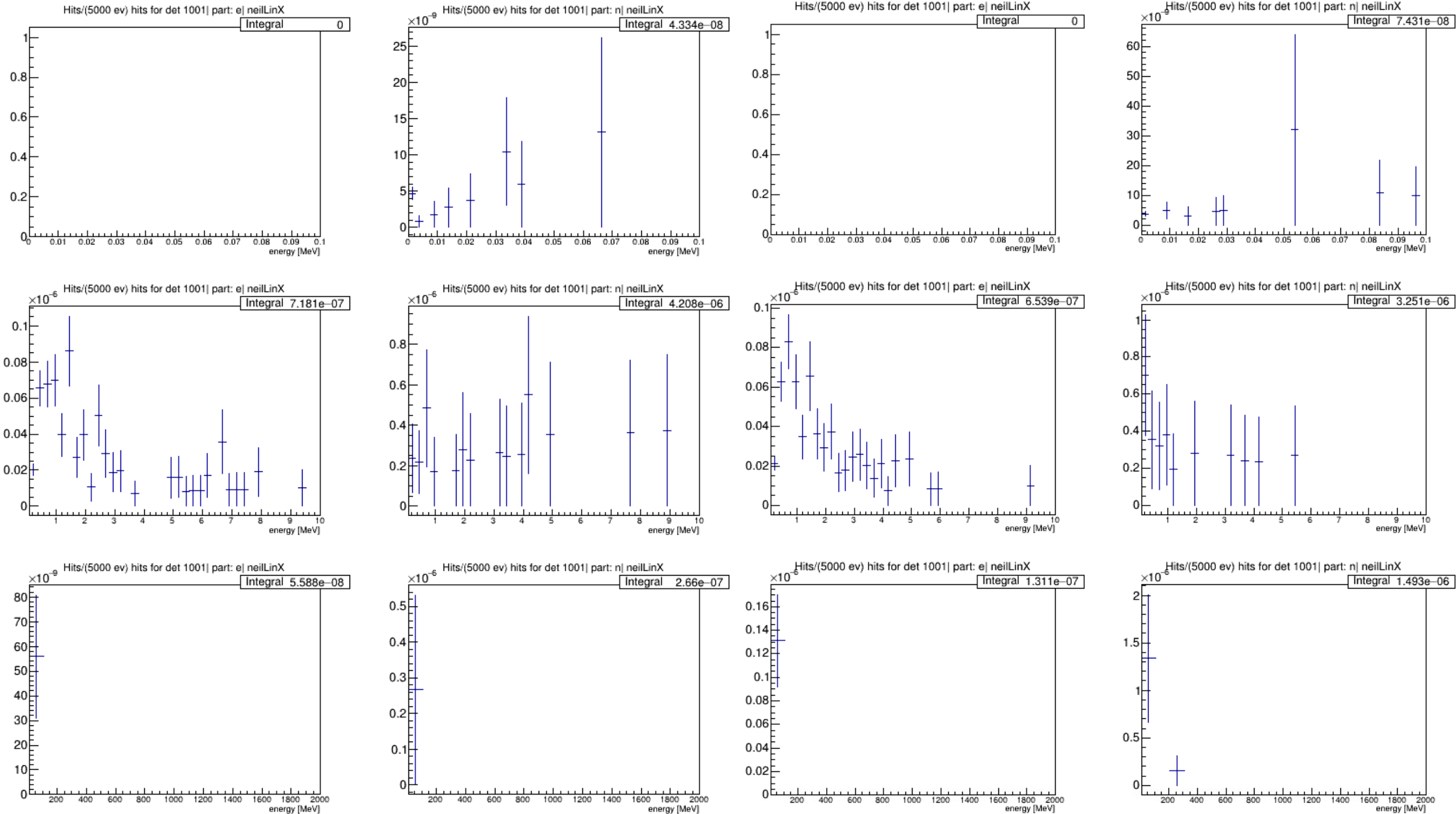
current setup



# CREX - comparison

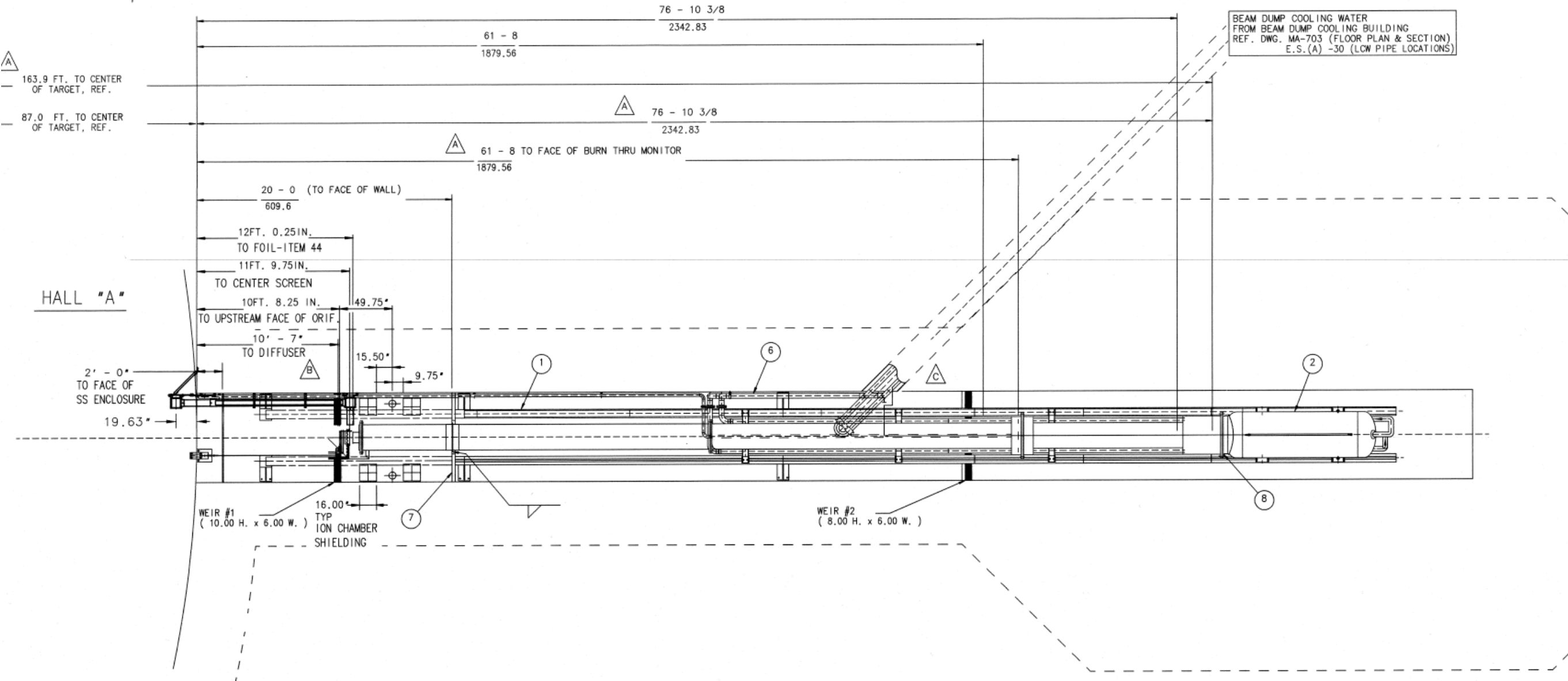
## current setup

## current setup + 2PipeSeptum+donut shield



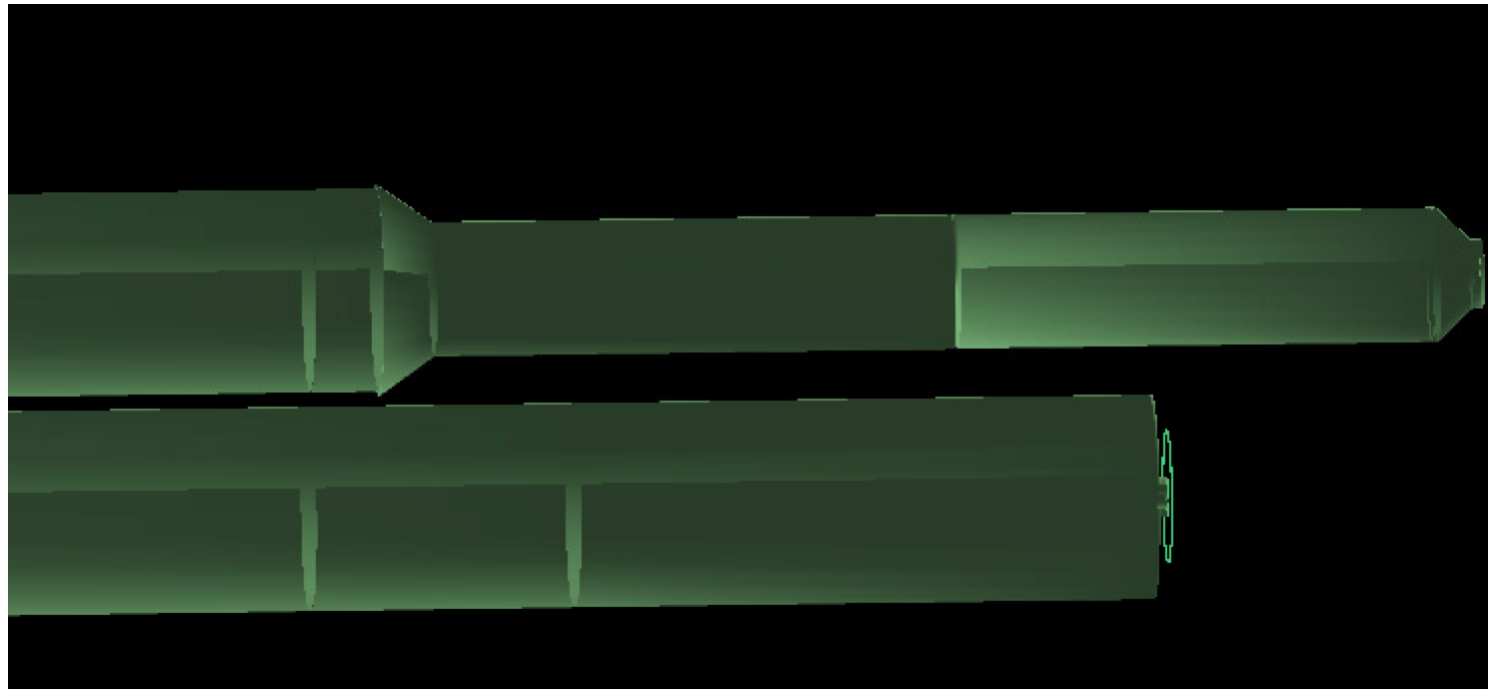


# PREX 1 dump configuration

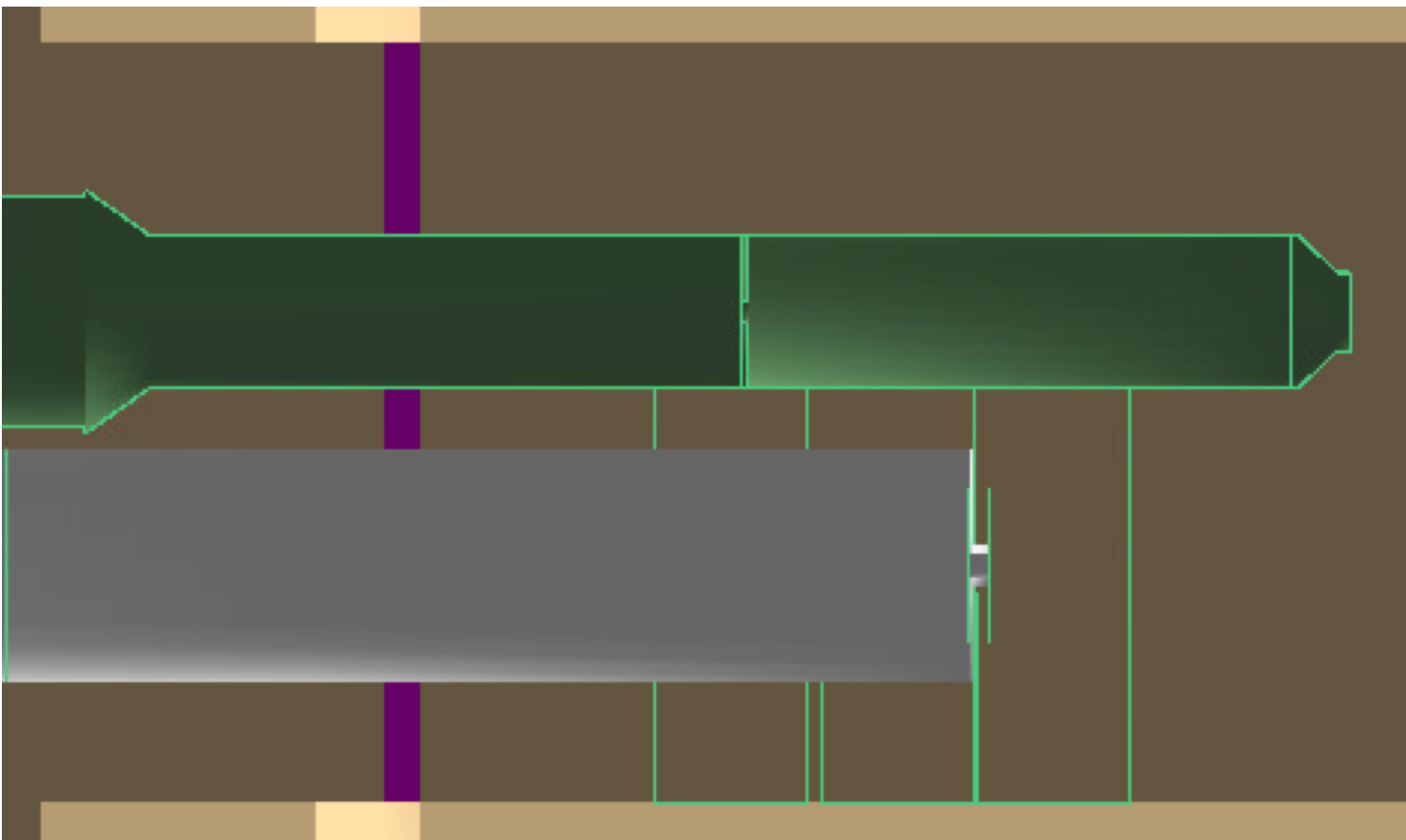


- Dump configuration was different than what we had in the simulation
- The beam pipe has an Aluminum aperture that is about 4in in diameter in about the same location as the donut is now

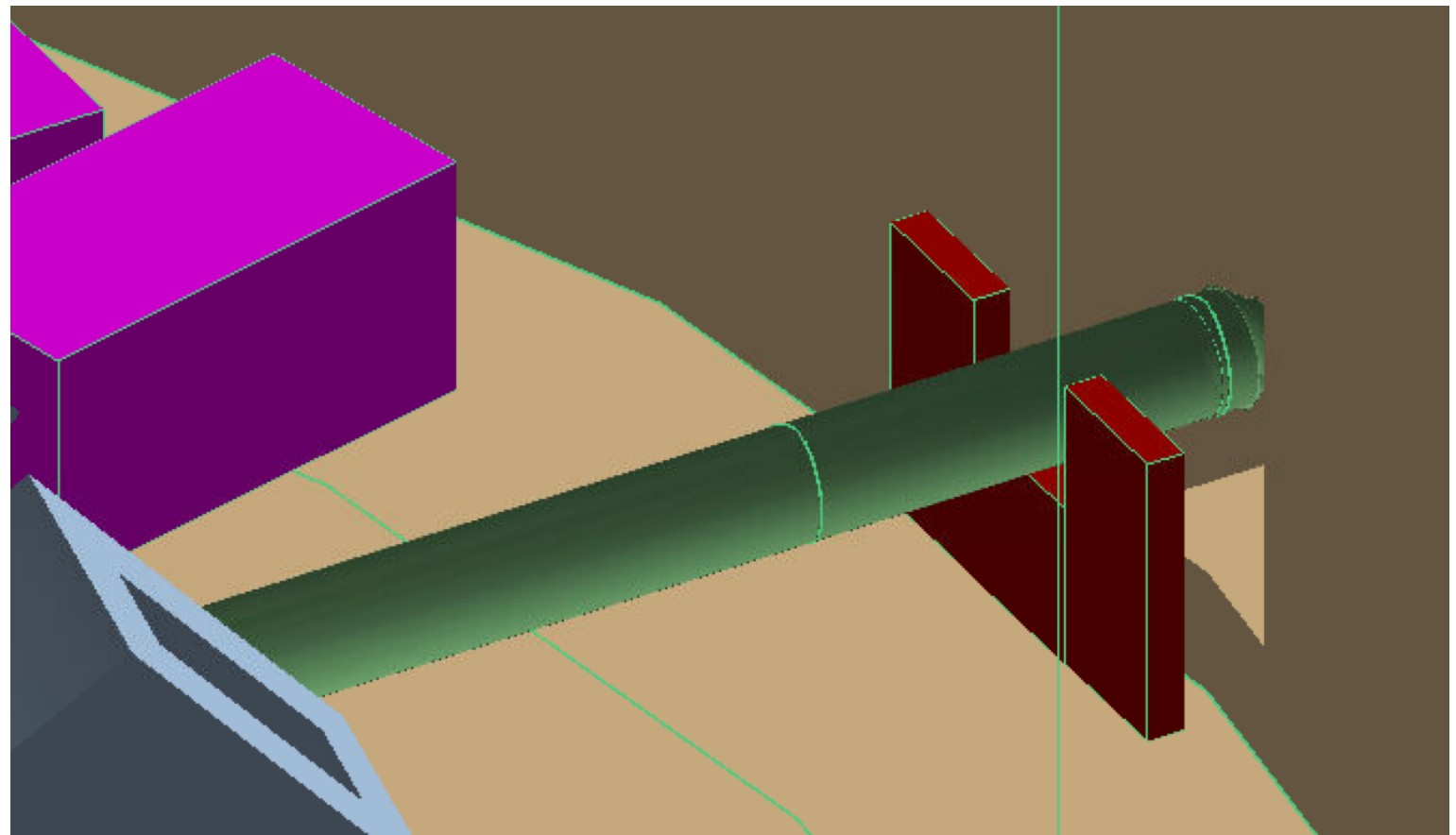
# GDML implementation



- Furthermore Kent noticed that the neck down in my configuration didn't match the drawing (or reality)
- now the neck-down is right after the wall similarly to what we have in the hall



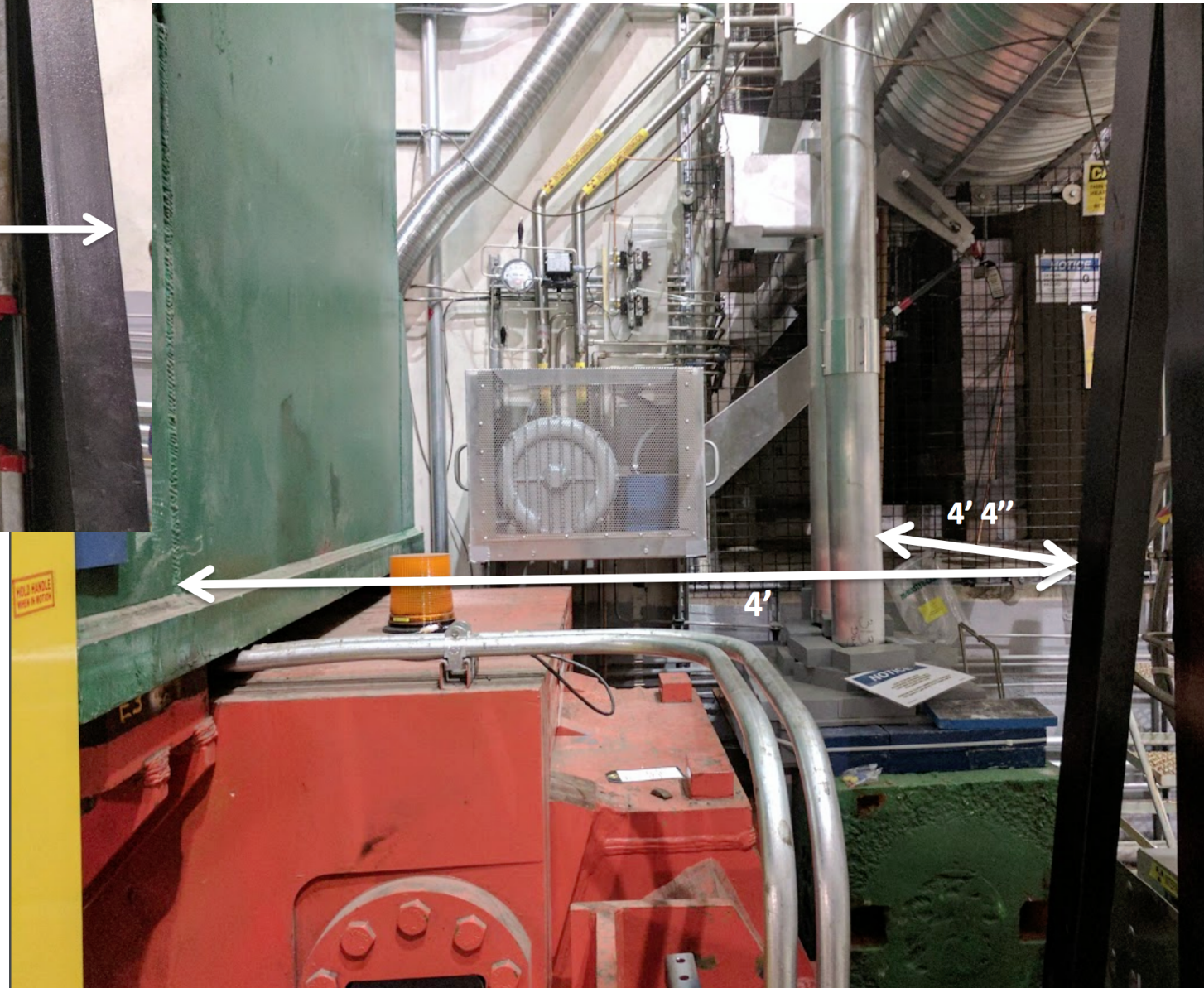
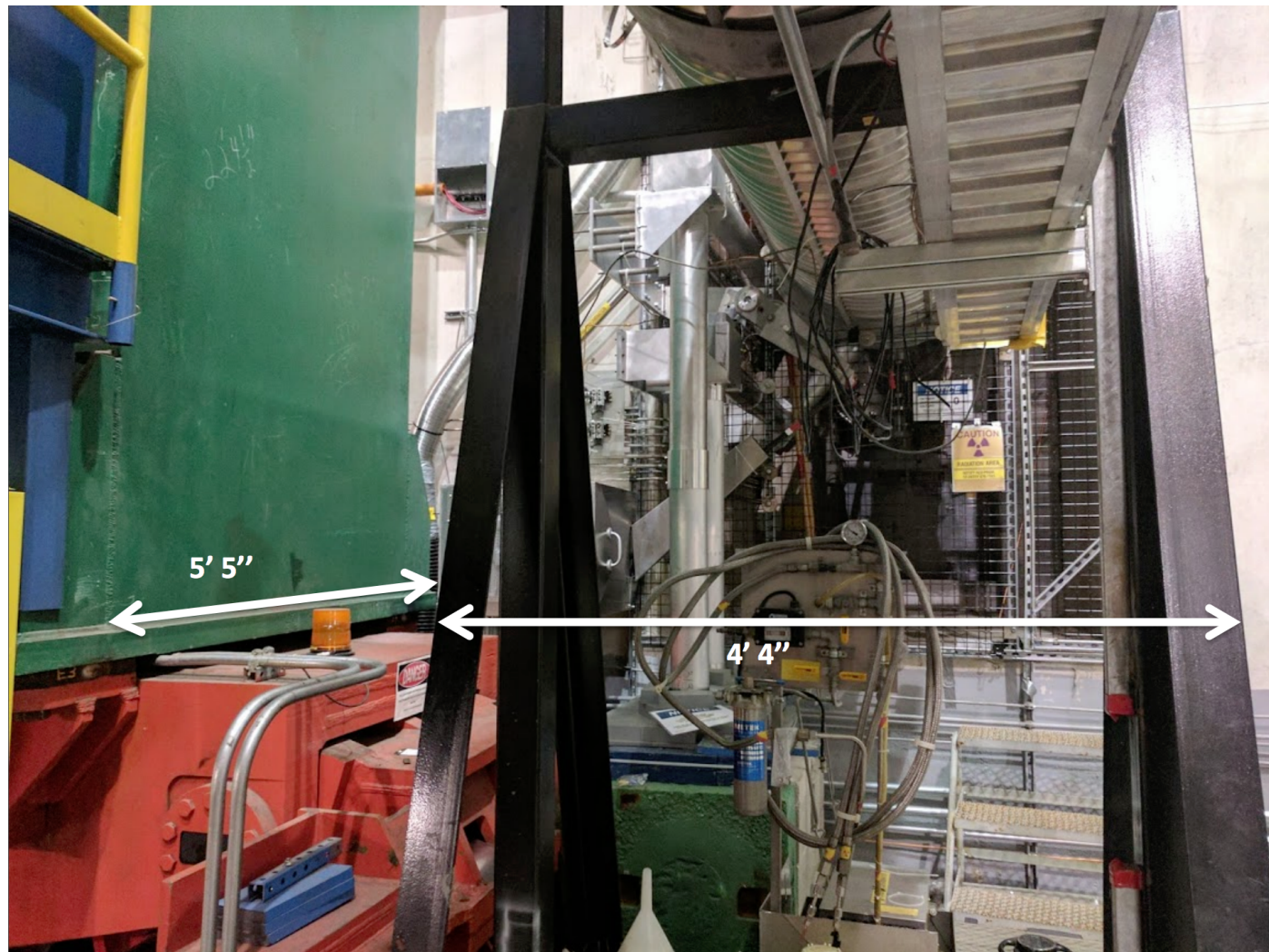
# Shielding concept



- Sanghwa, Dave and I went over to the hall and we made some measurement of the space available to us with the HRS parked in the 12.5 deg position
- I implemented 3 simple 1 foot thick shielding blocks in the simulation (ran for both concrete and Polyethylene)



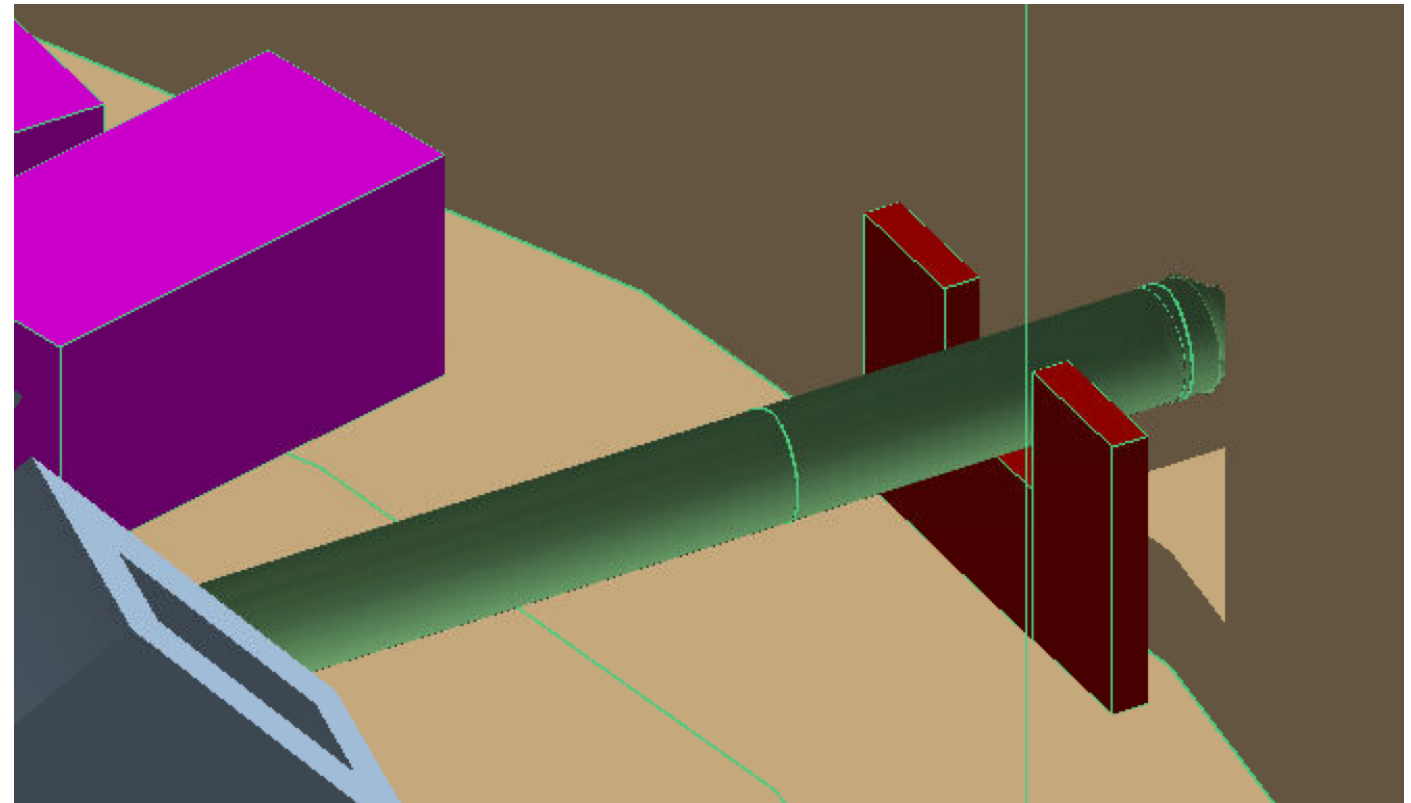
# Hall Configuration



- 10 cm thick Steel wall (in green) is not present in our simulation



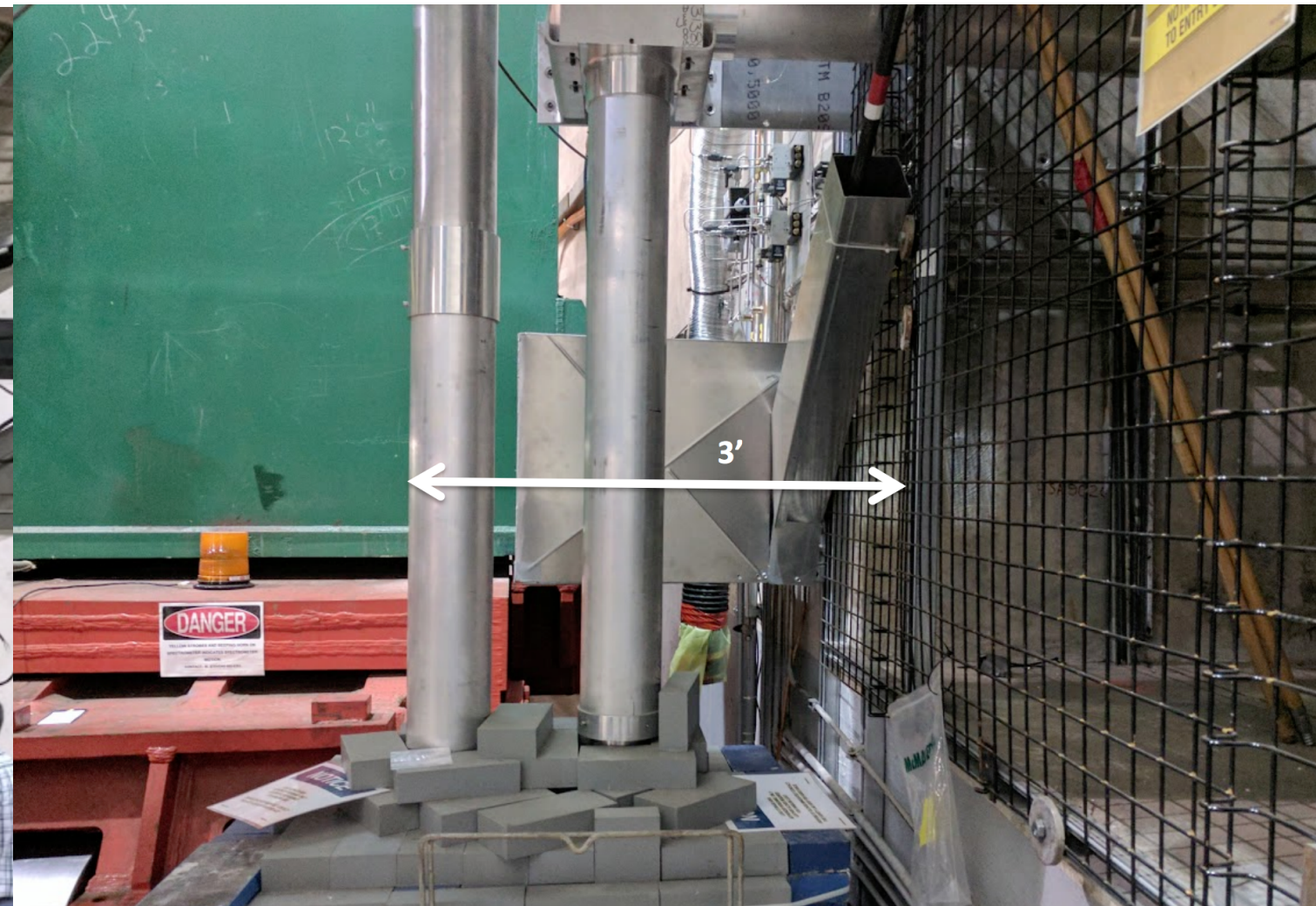
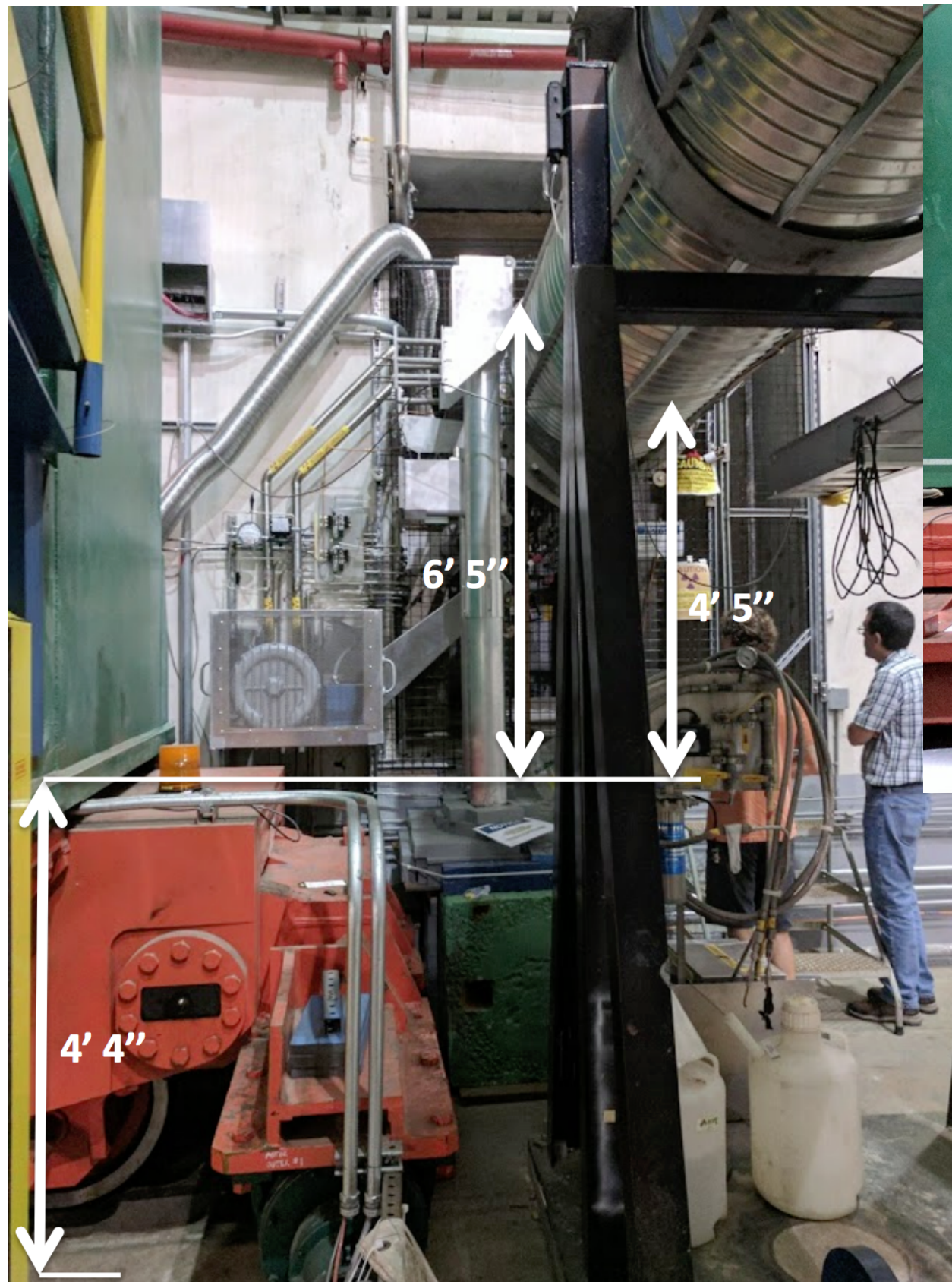
# Hall Configuration



- 10 cm thick Steel wall (in green) is not present in our simulation
- moreover, the hrs “electronics box” we have now doesn’t cover the whole area where electronics exist and may be too forward



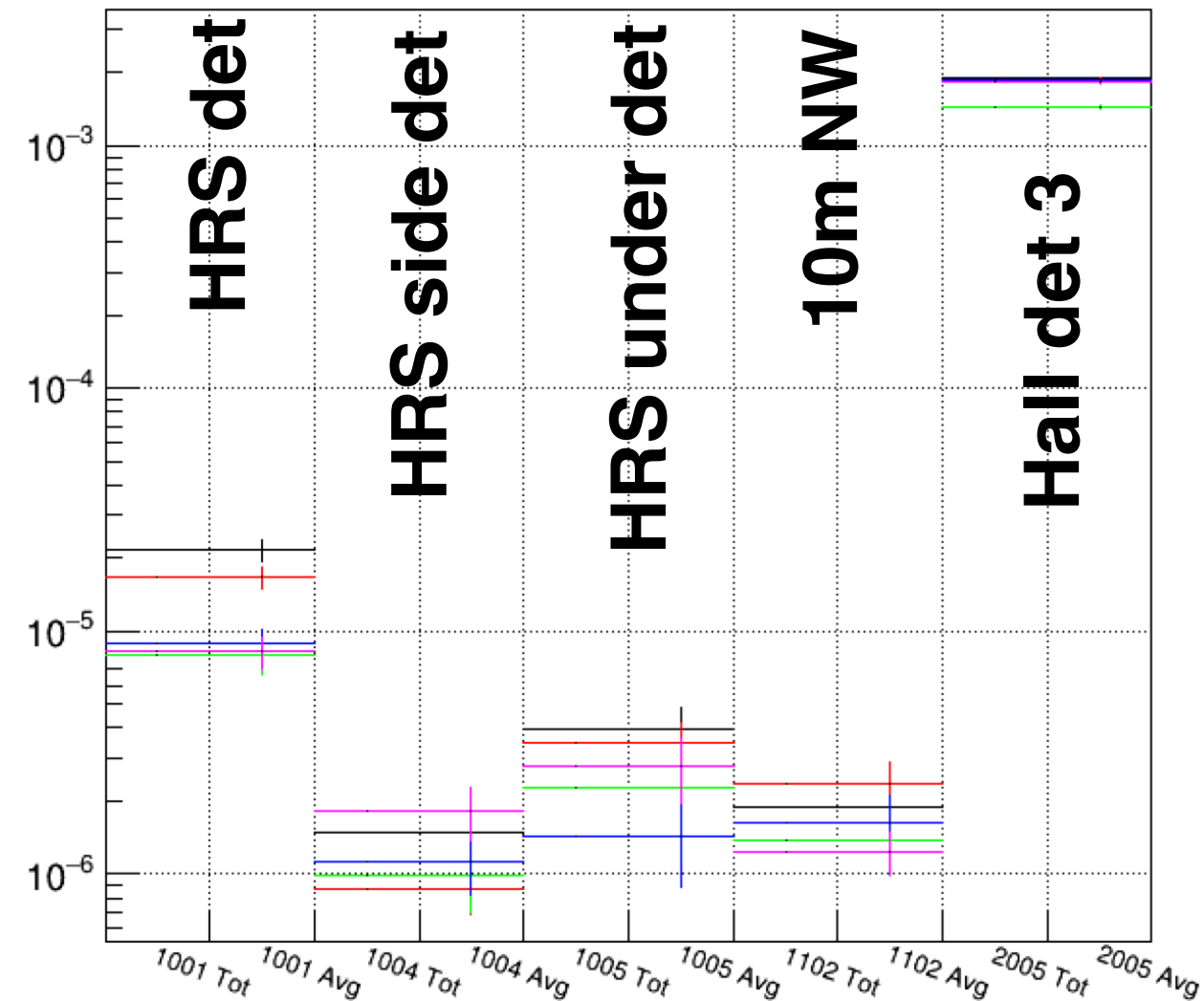
# Hall Configuration





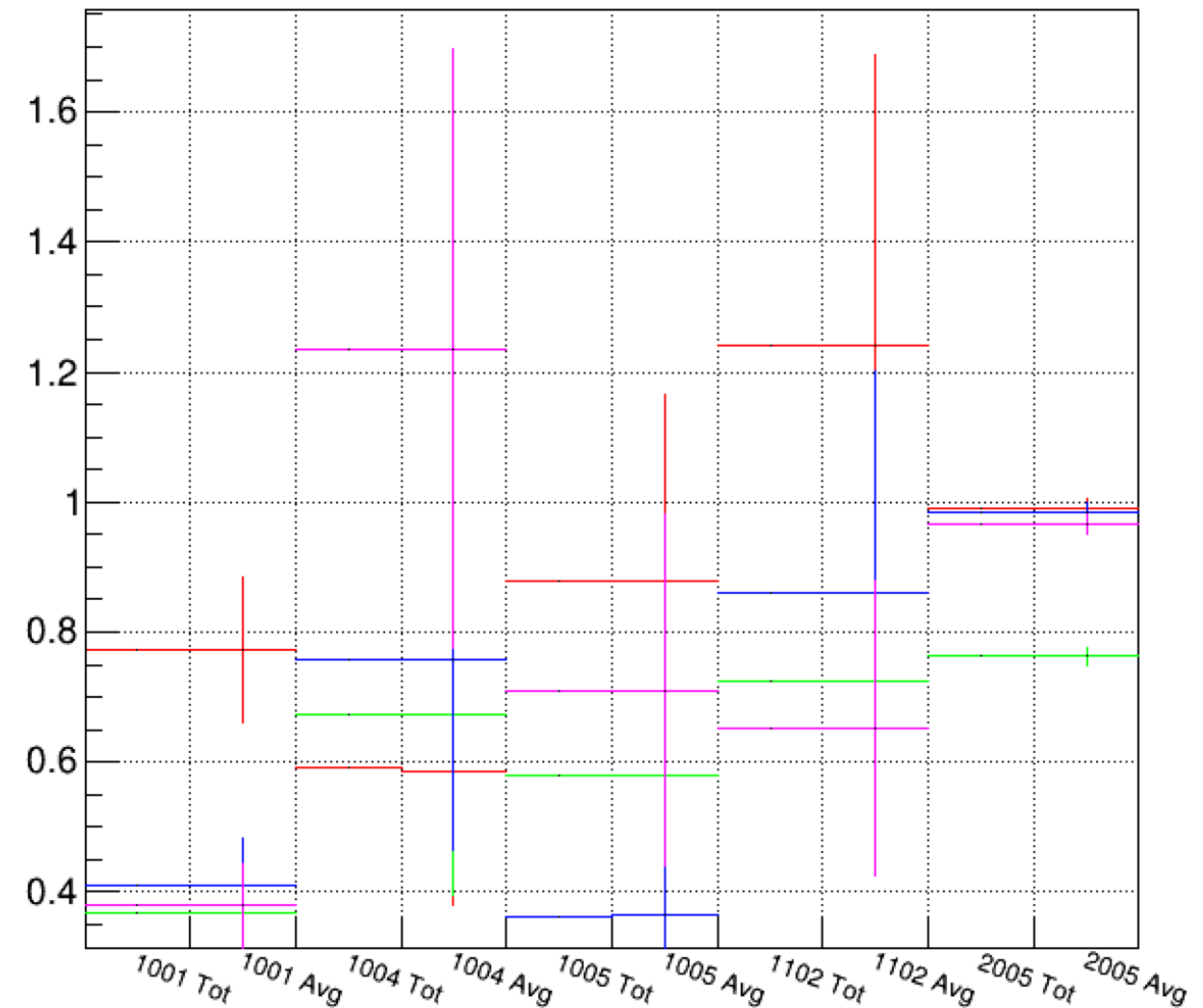
# PREX2 - HRS rad damage

summary histogram per electron on target| neilLogX



**Black: current setup**  
**Red: current setup + 4 in donut**  
**Green: PREX 1 dump**  
**Blue: current setup + concrete Shield**  
**Magenta: current setup + Poly Shield**

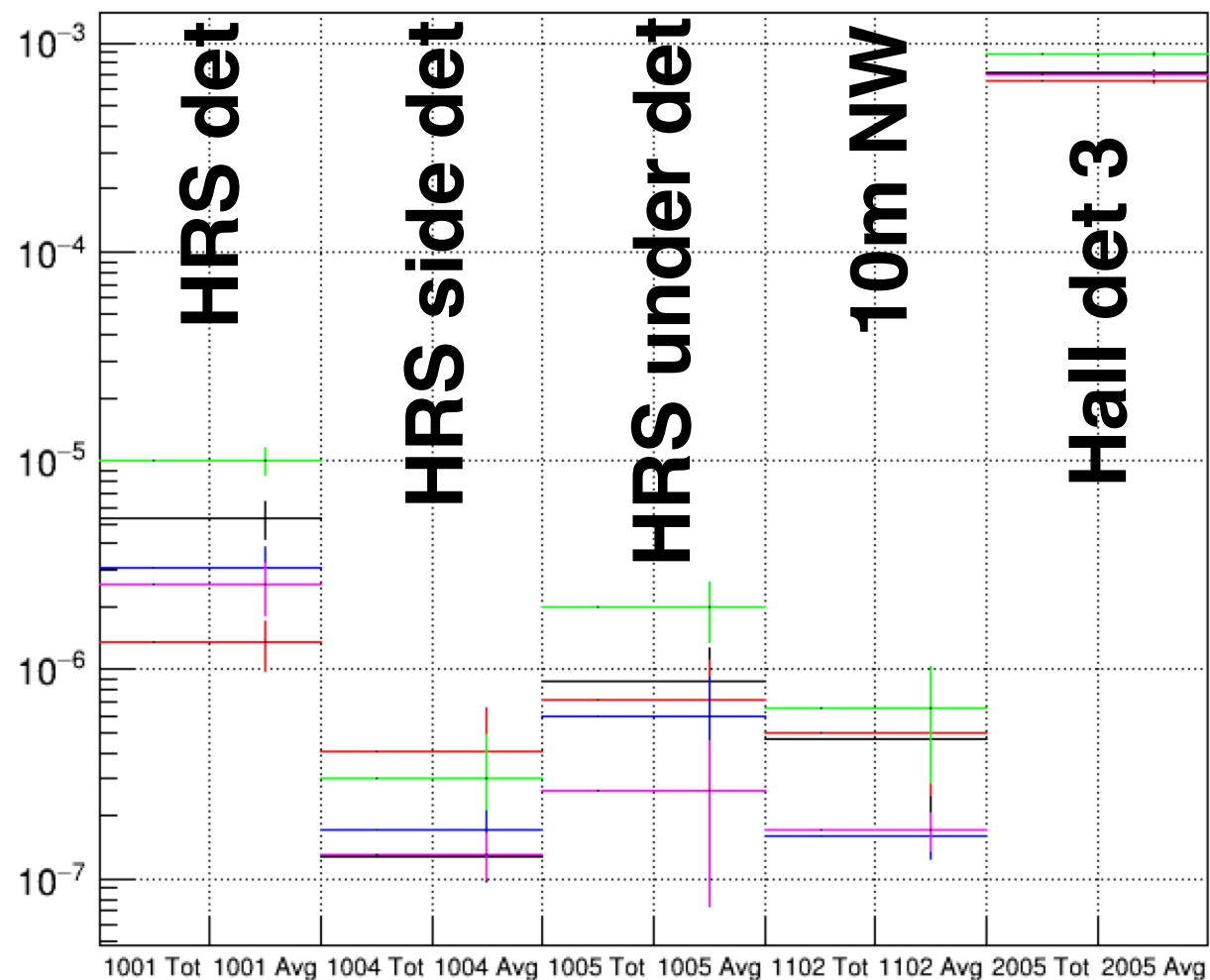
summary histogram per electron on target| neilLogX



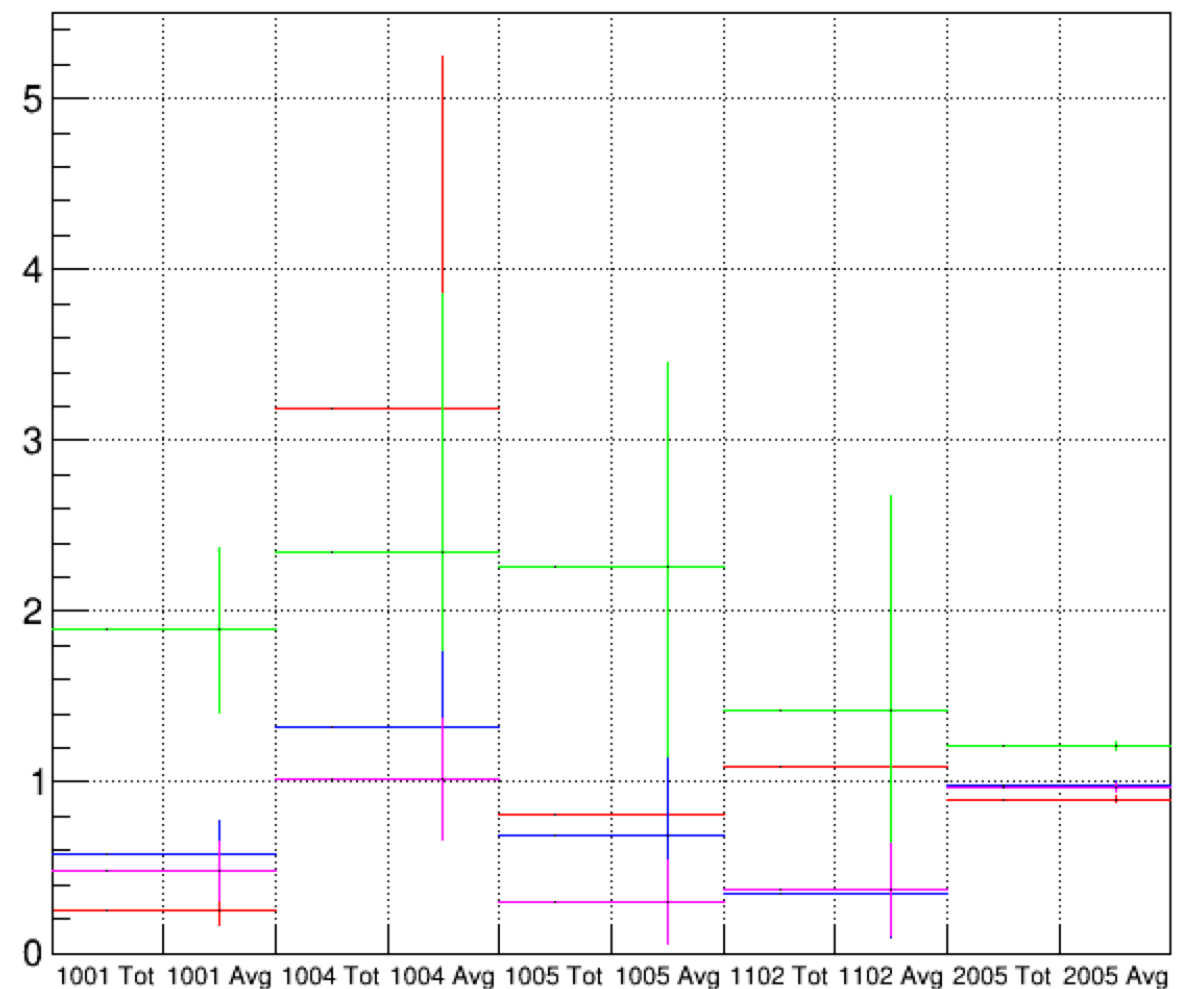
- Best configuration seems to be the PREX1 beam pipe, followed closely by the current pipe with shielding

# CREX - HRS rad damage

summary histogram per electron on target| neilLogX



summary histogram per electron on target| neilLogX



**Black: current setup**

**Red: current setup + 4 in donut**

**Green: PREX 1 dump**

**Blue: current setup + concrete Shield**

**Magenta: current setup + Poly Shield**

- For CREX having a large aperture can provide significant improvement

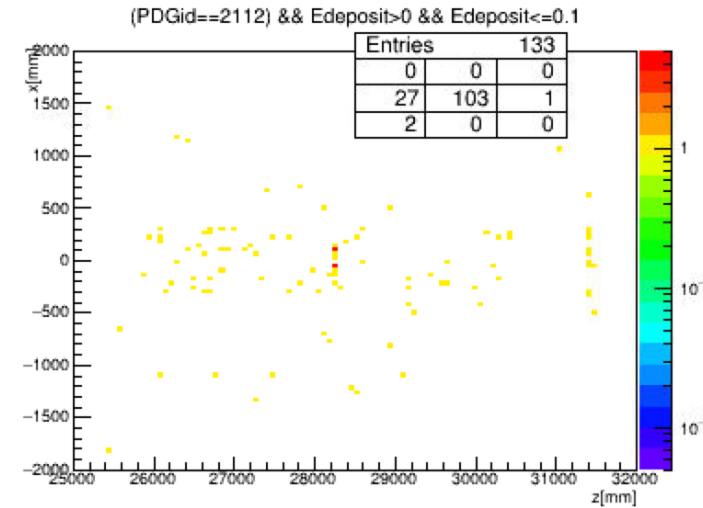
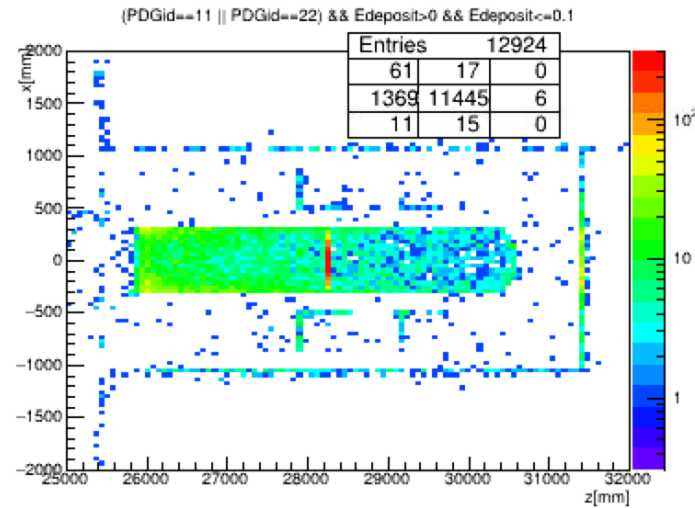
# Plots with electrons plus gammas

# PREX2 - current dump

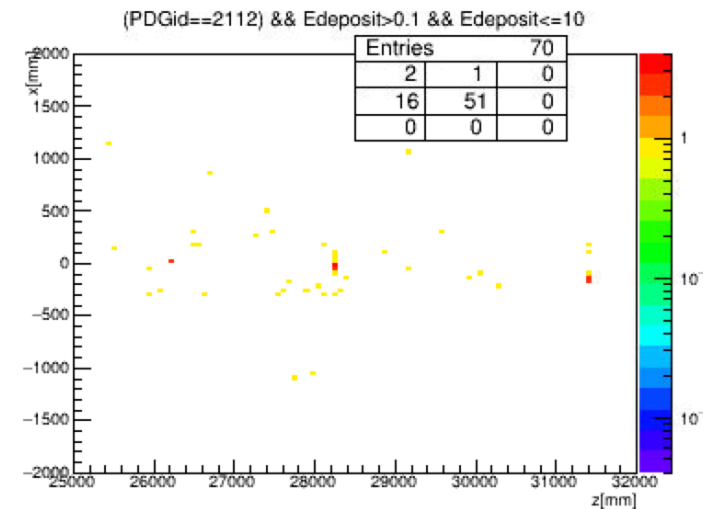
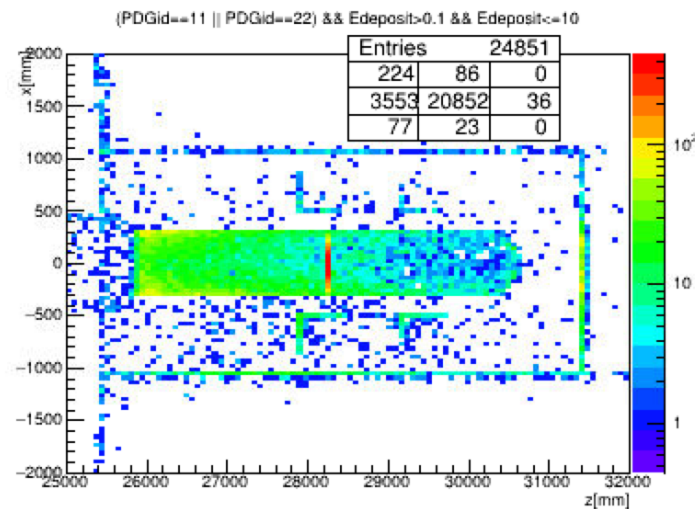
electrons+photons

neutrons

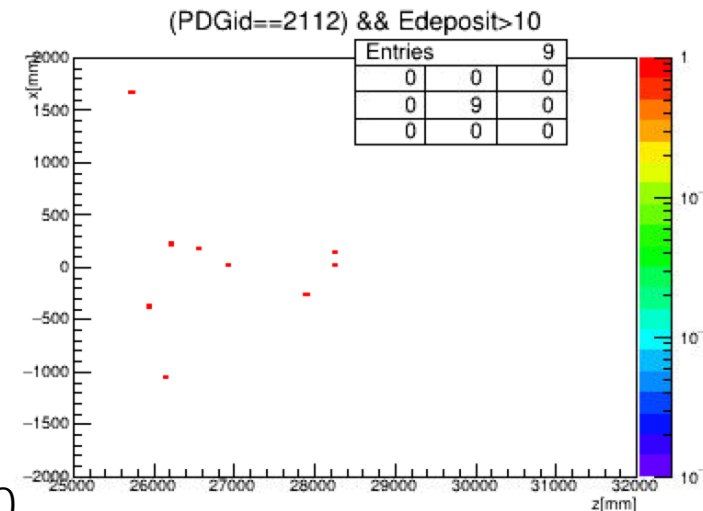
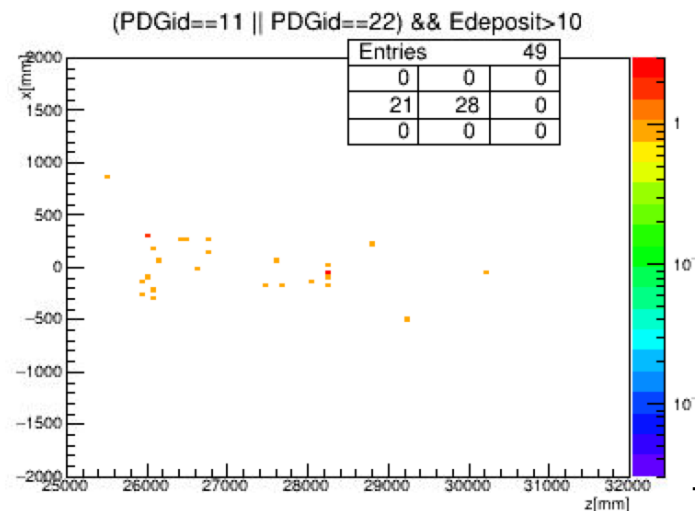
$0 < E \leq 0.1$  MeV



$0.1 < E \leq 10$  MeV



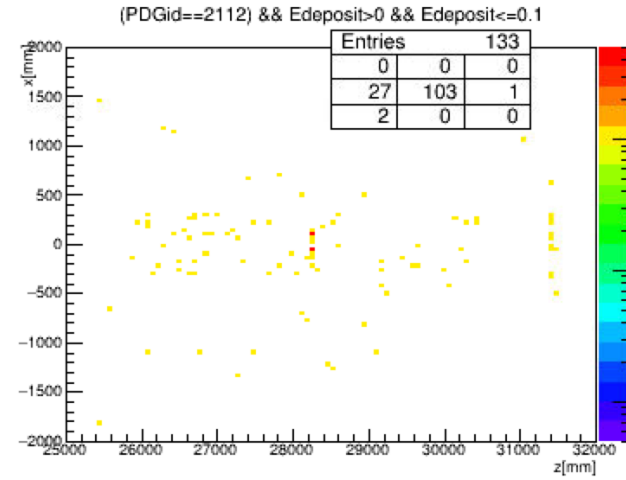
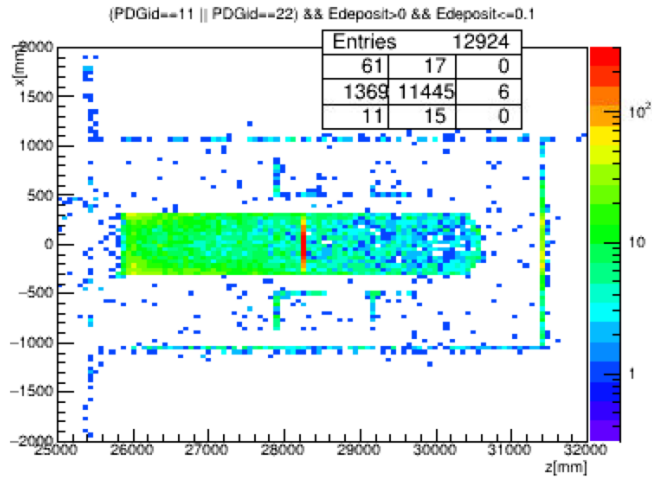
$10 < E$  MeV



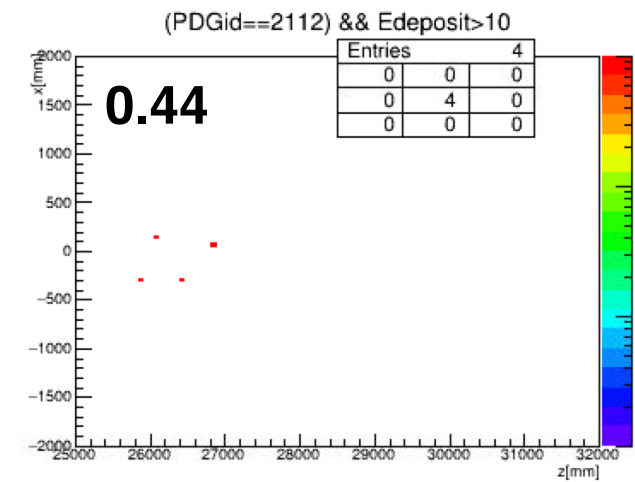
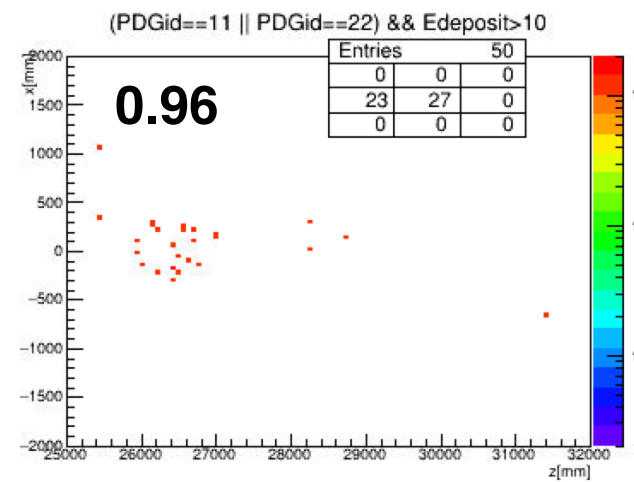
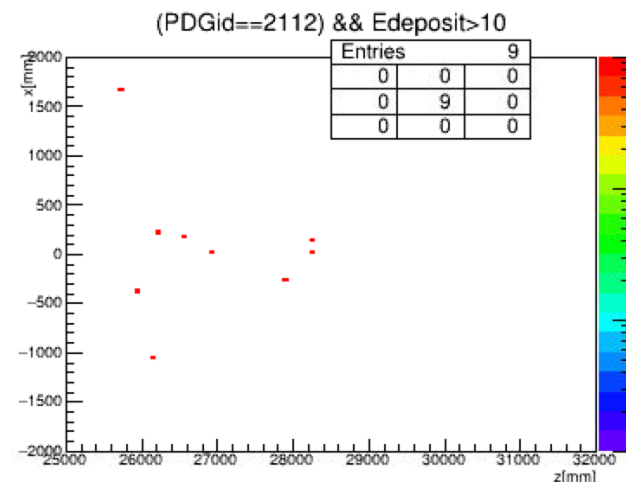
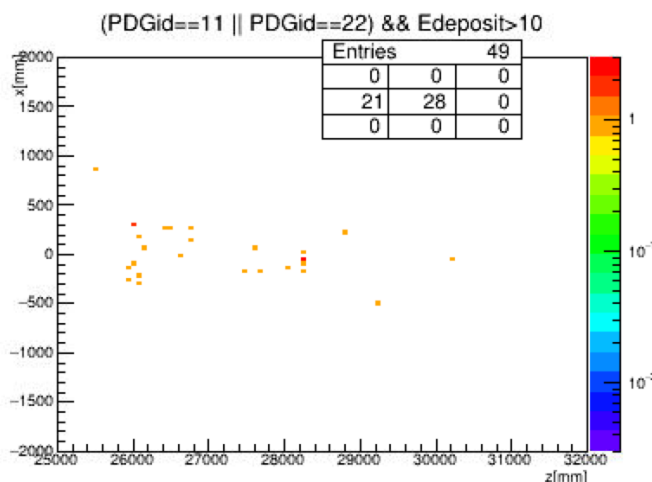
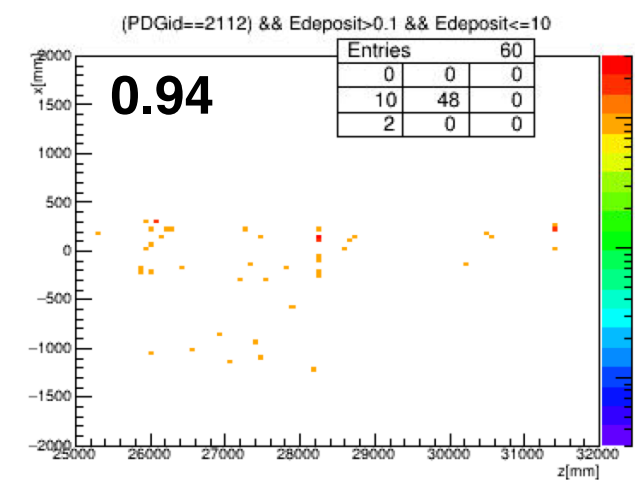
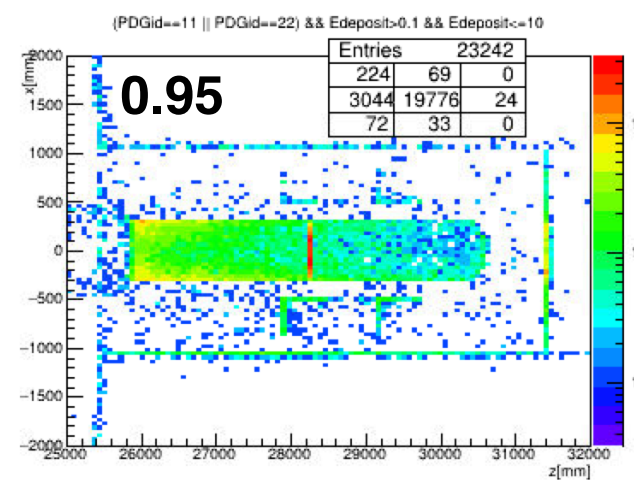
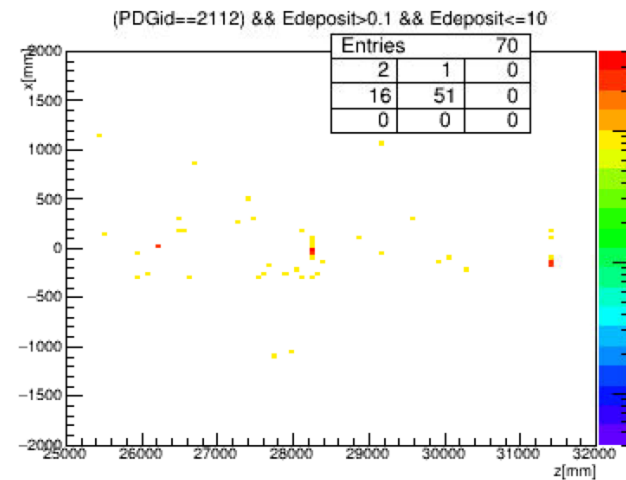
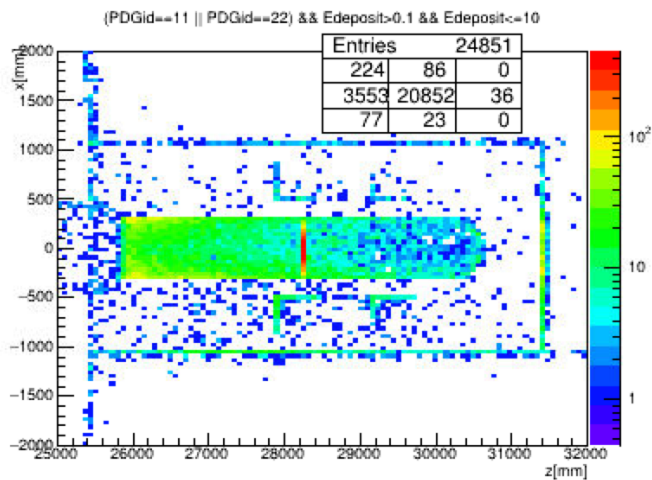
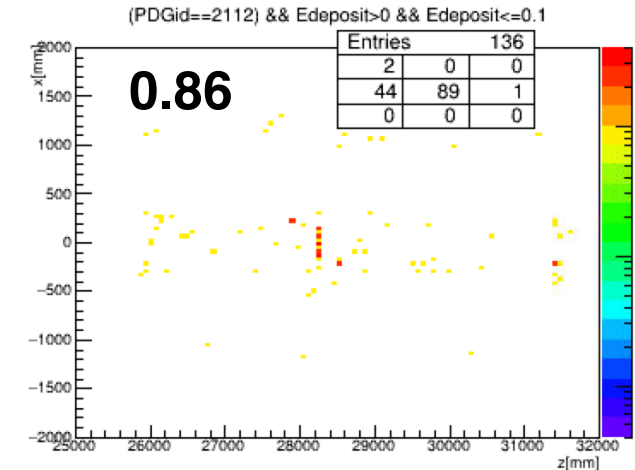
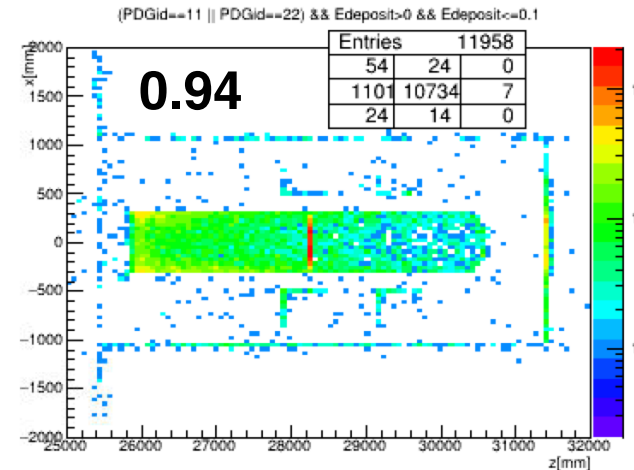


# PREX2 - comparison

## current setup

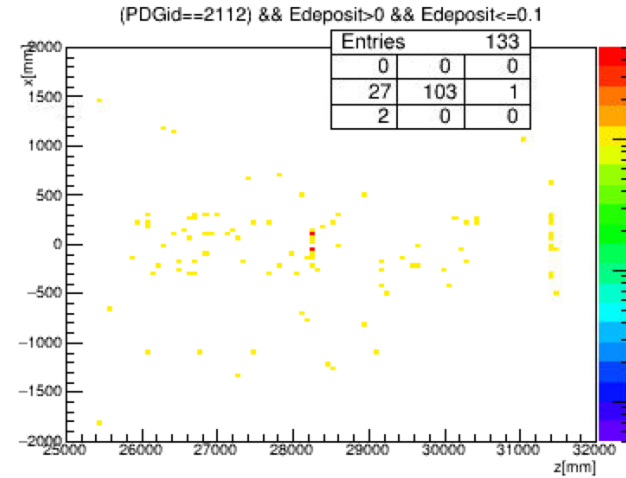
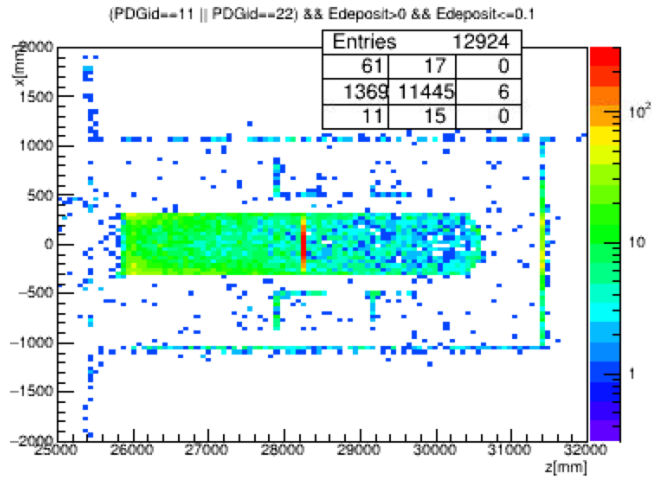


## current setup + 4 in donut

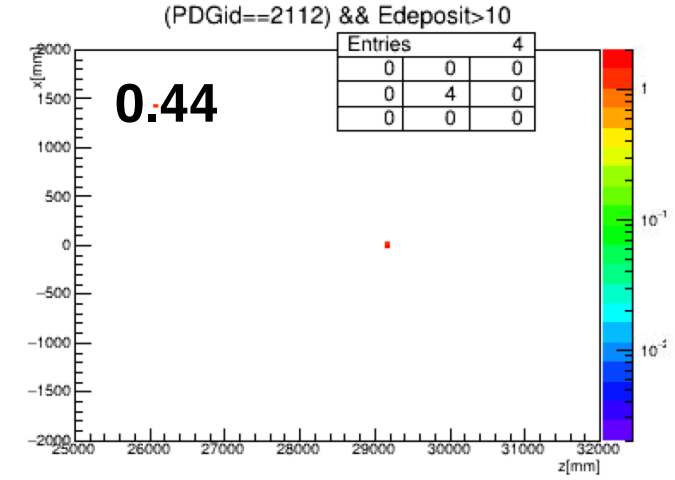
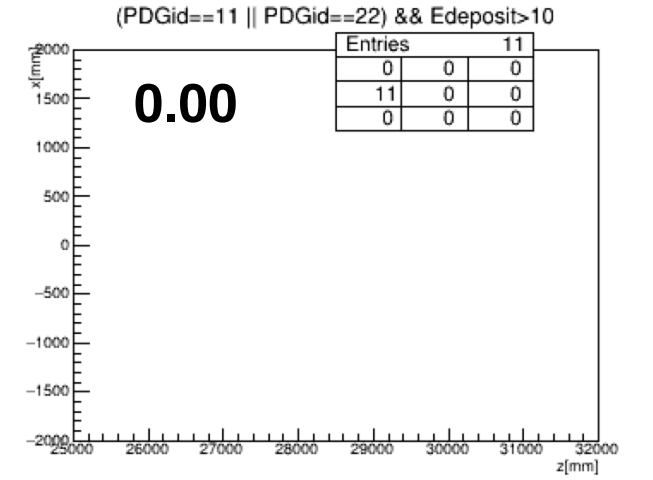
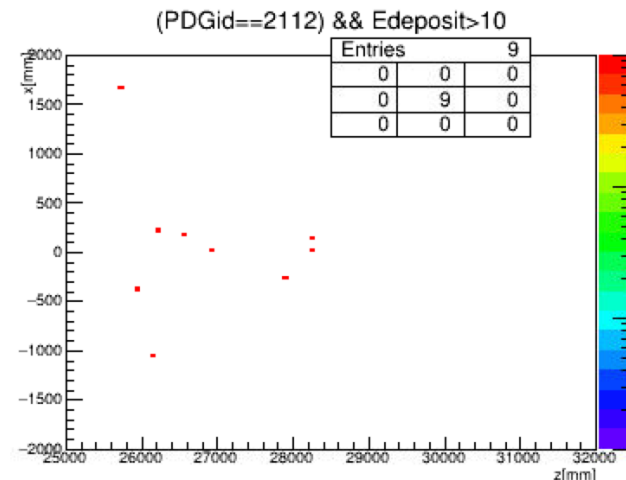
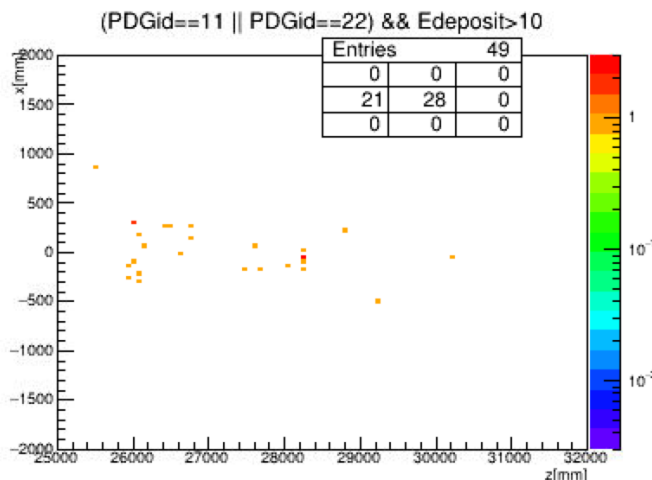
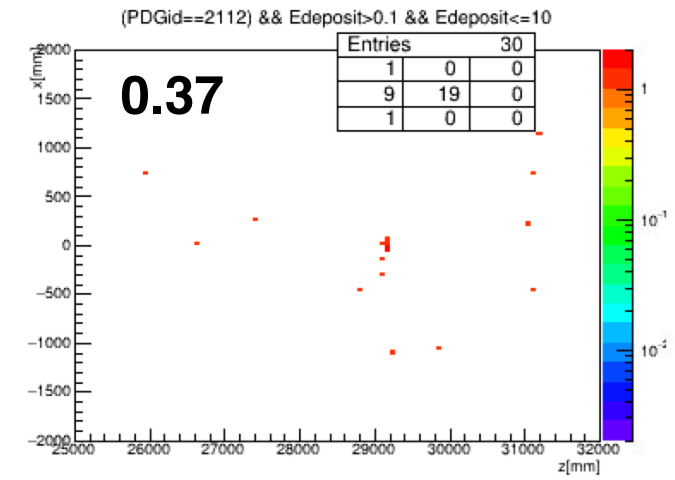
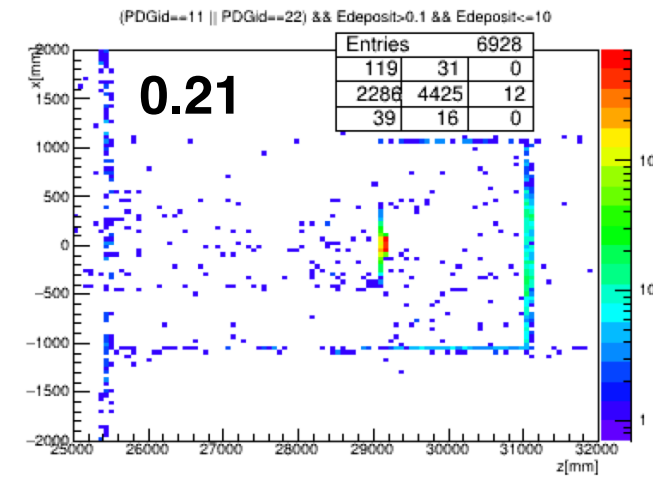
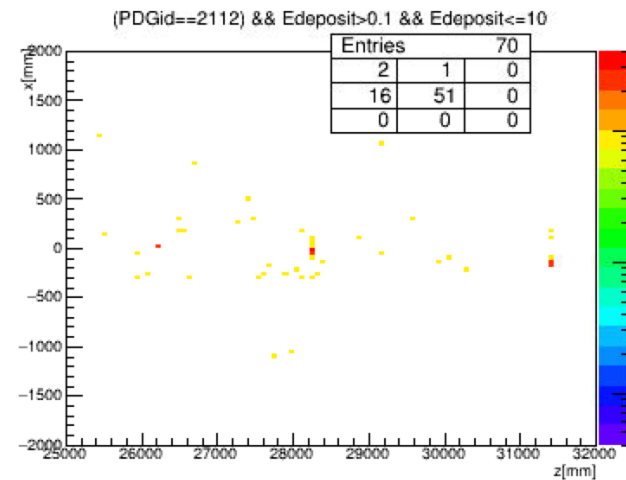
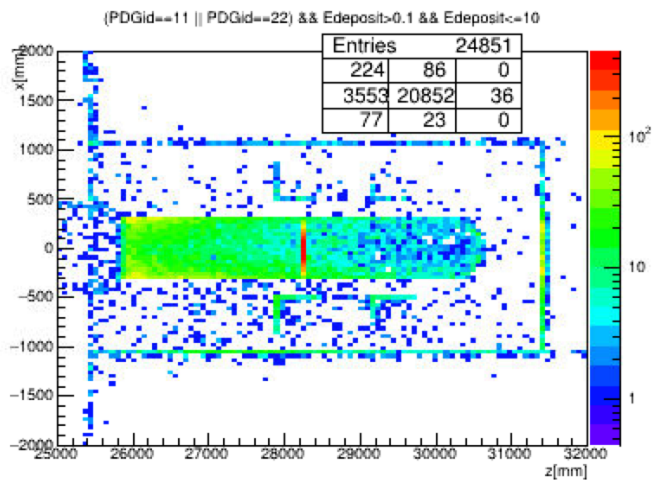
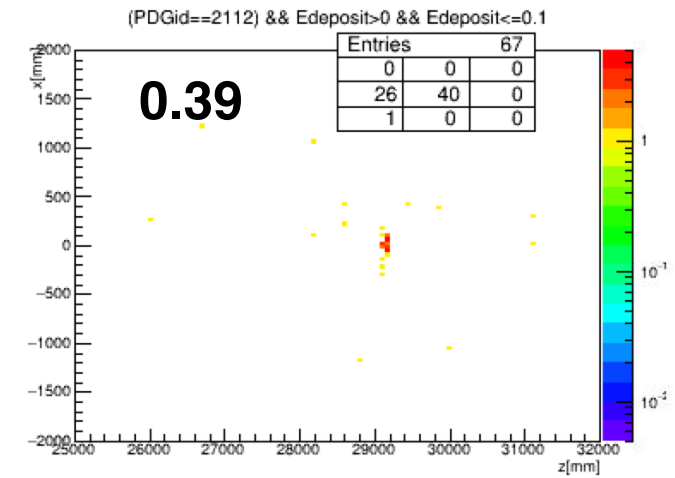
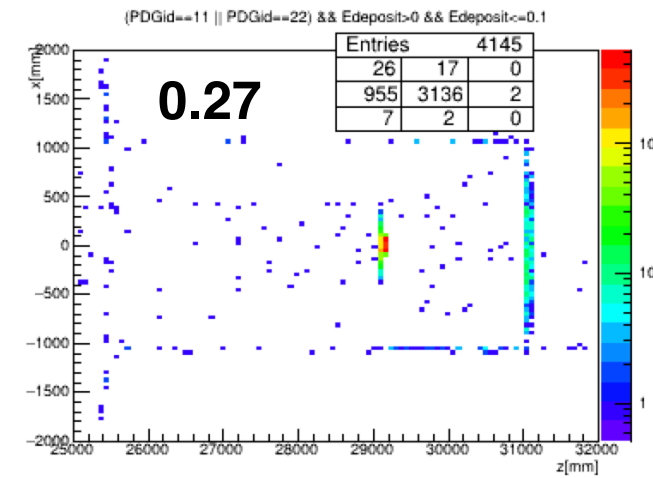


# PREX2 - comparison

## current setup

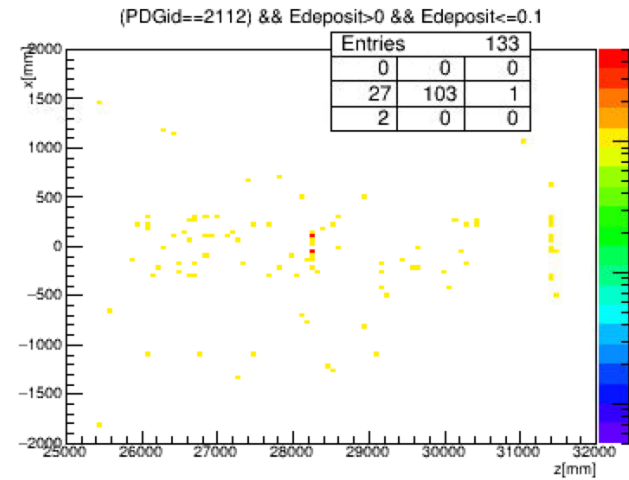
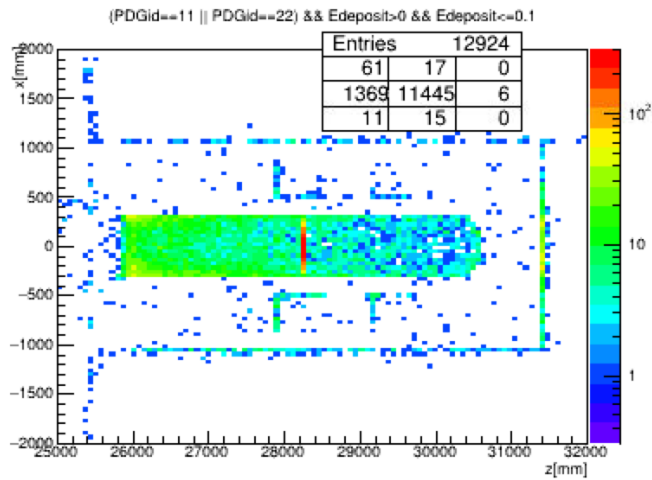


## PREX1 dump configuration

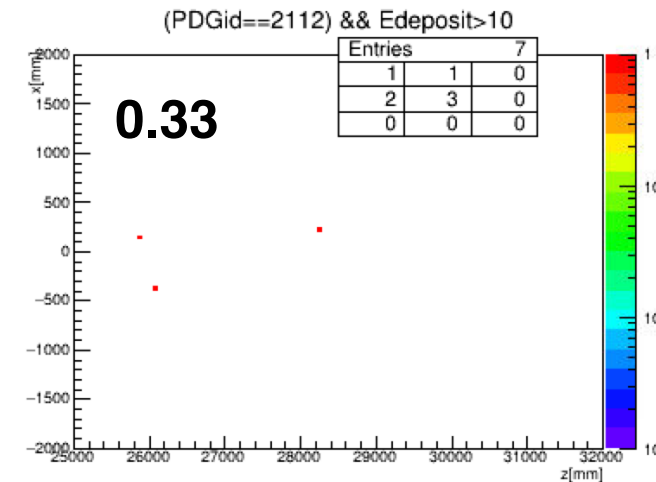
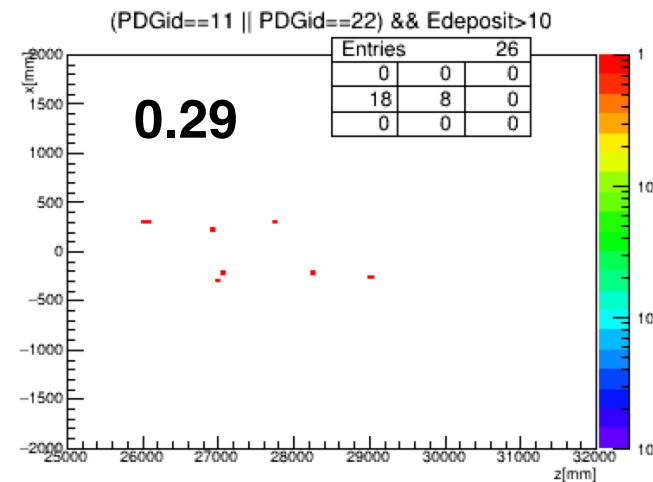
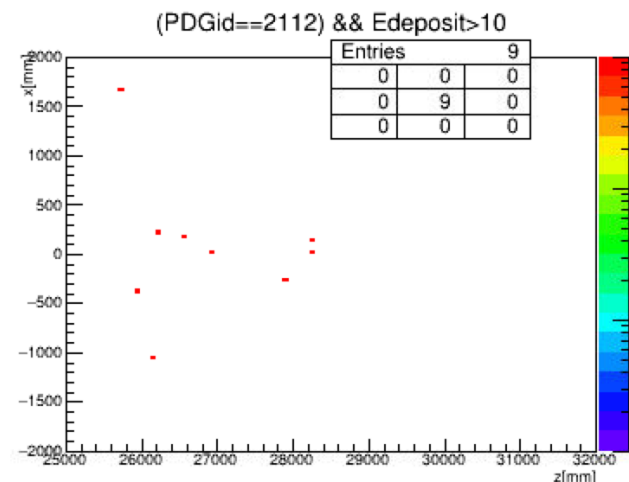
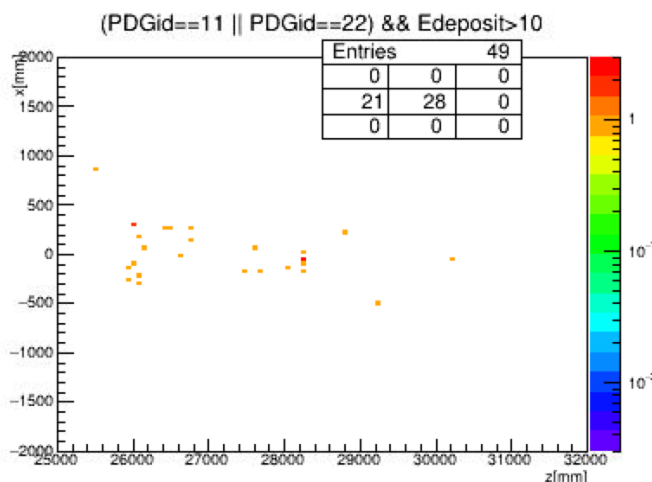
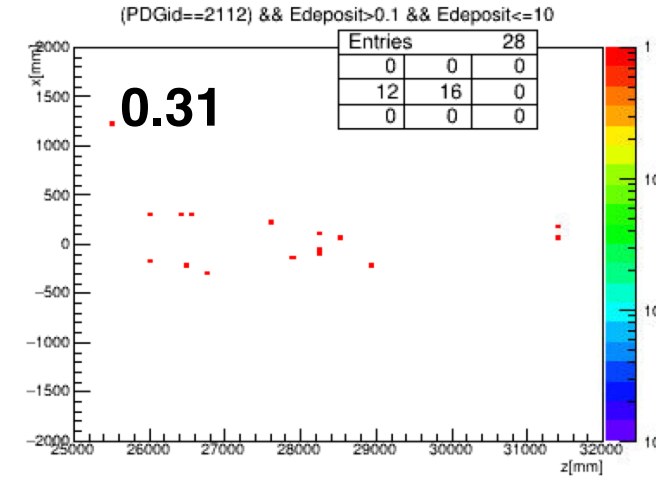
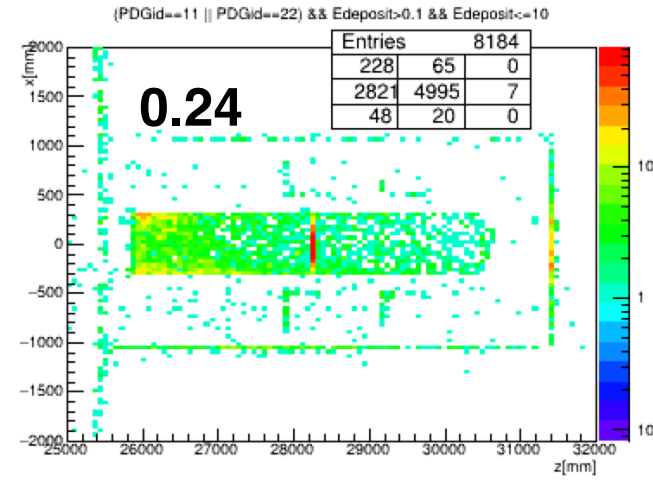
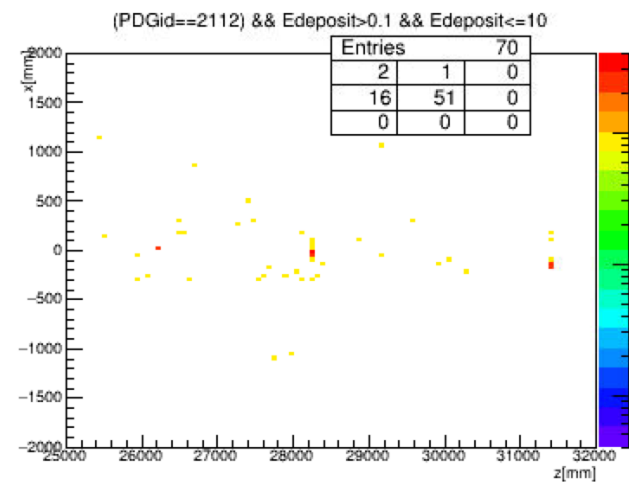
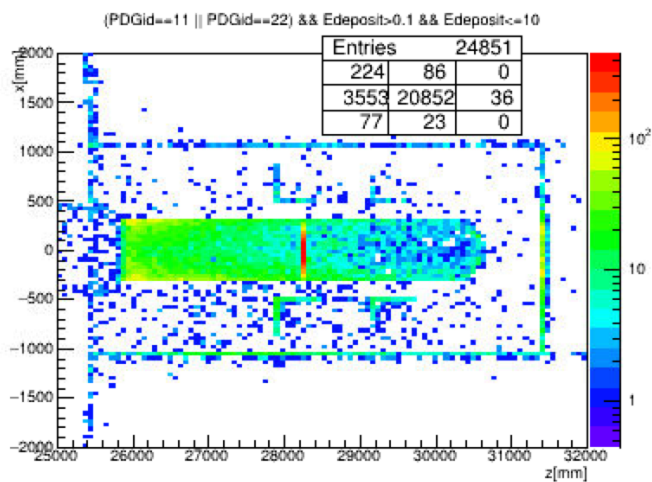
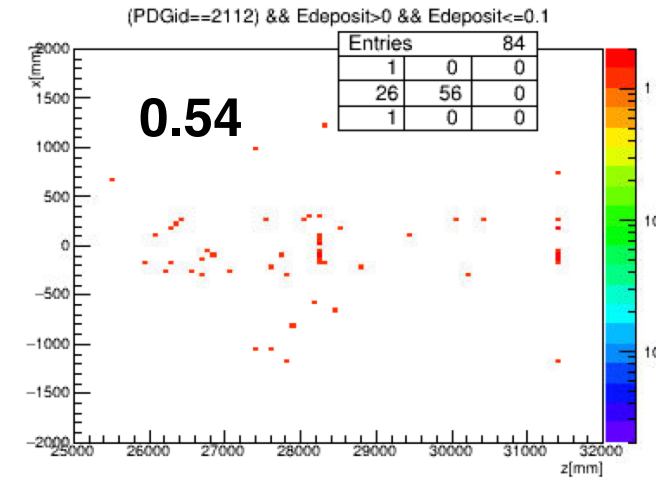
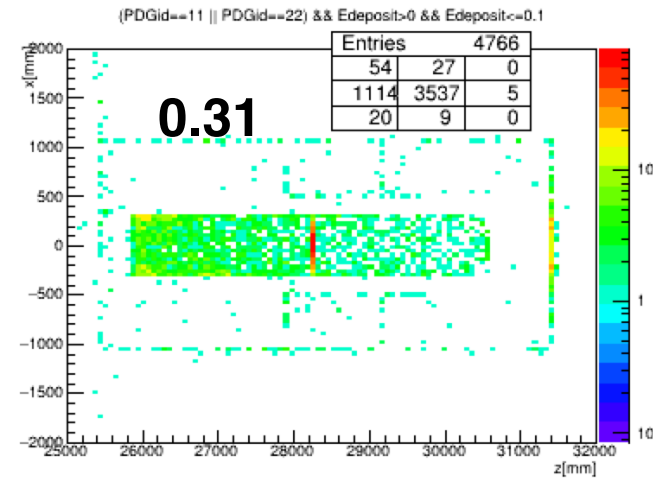


# PREX2 - comparison

## current setup



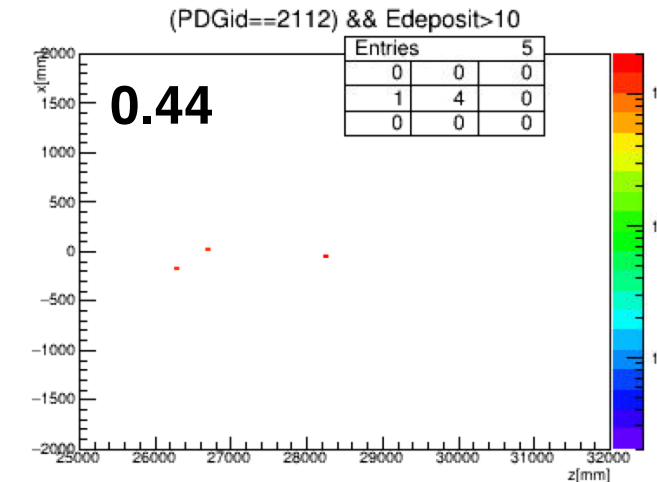
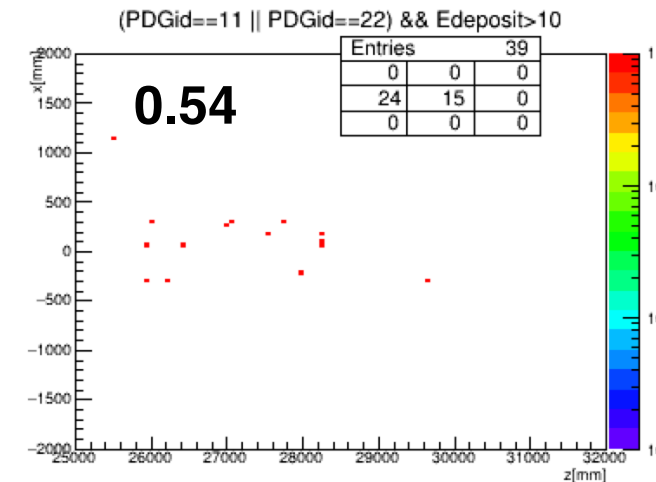
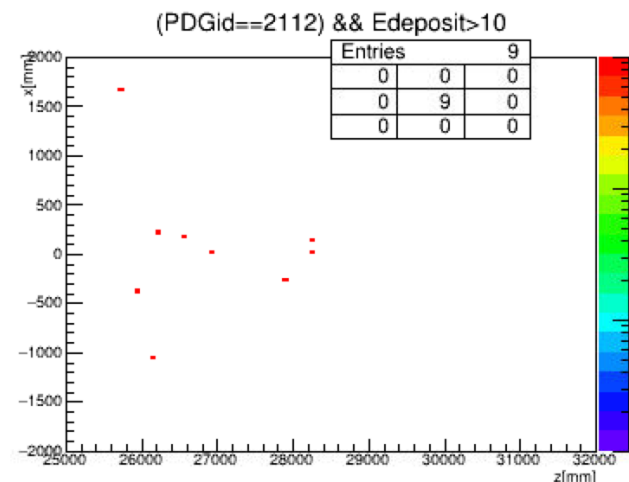
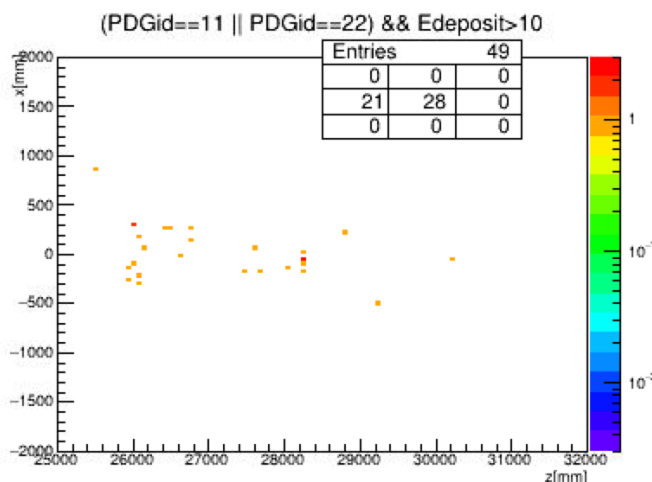
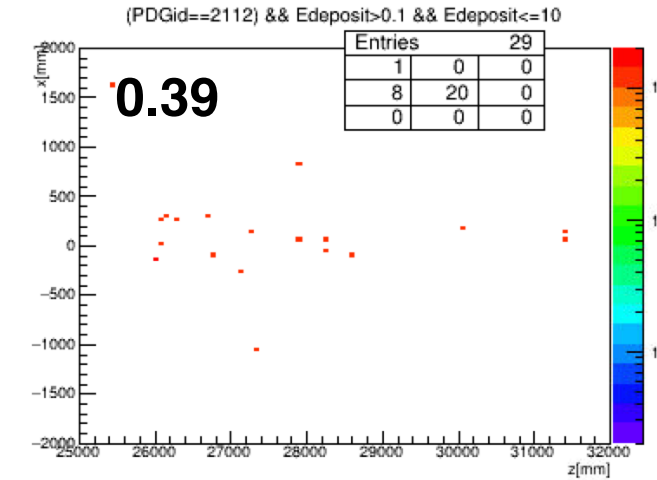
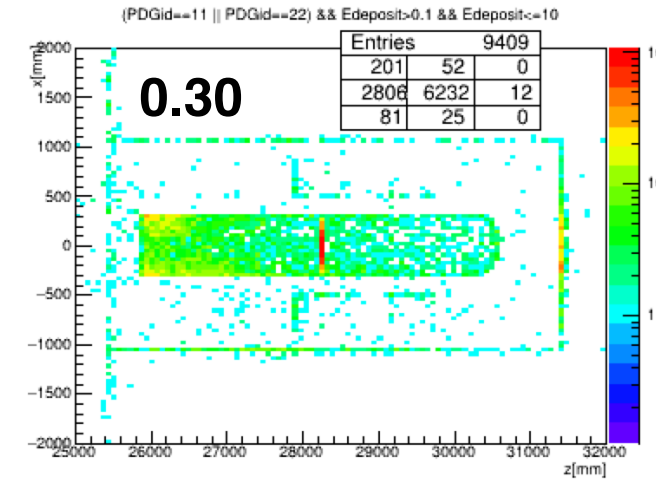
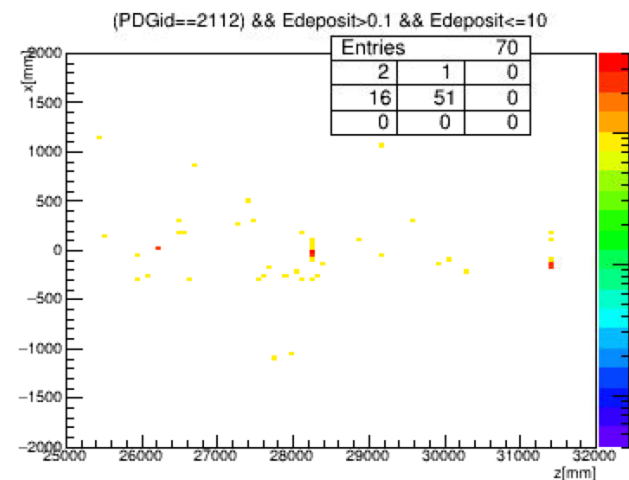
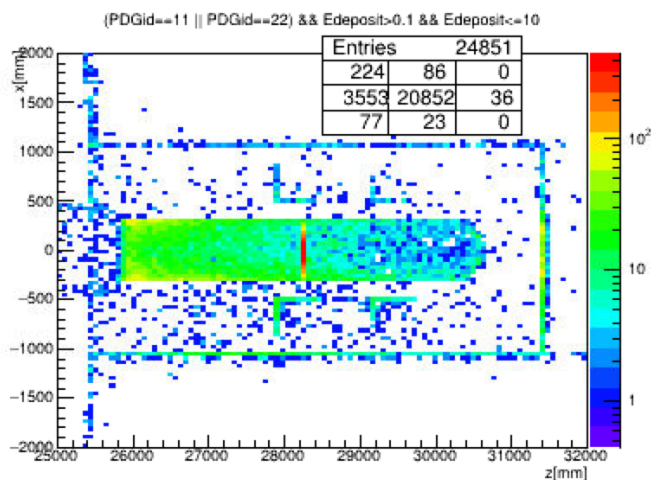
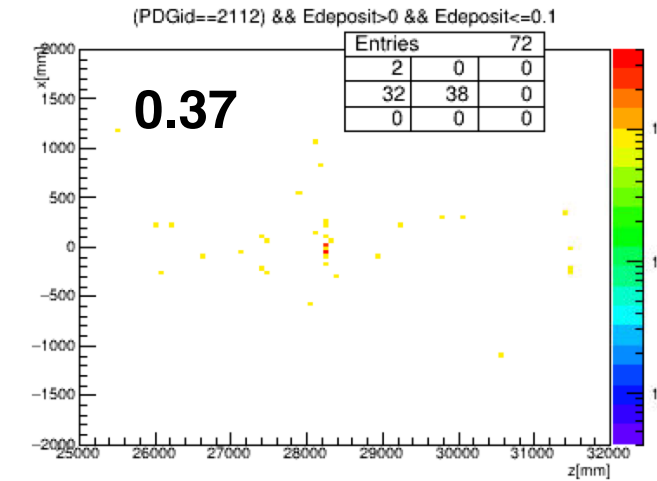
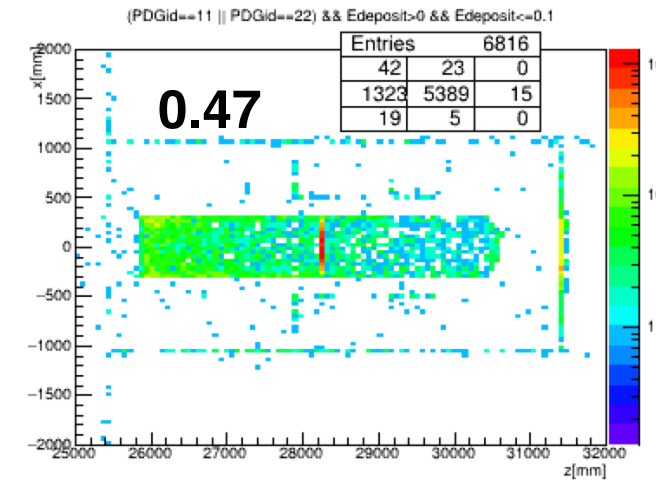
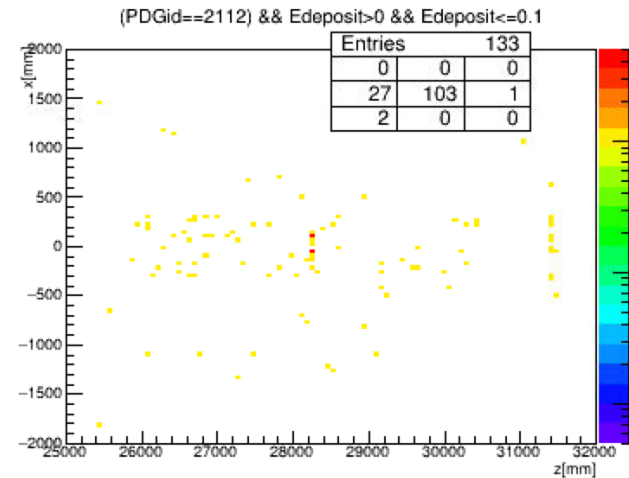
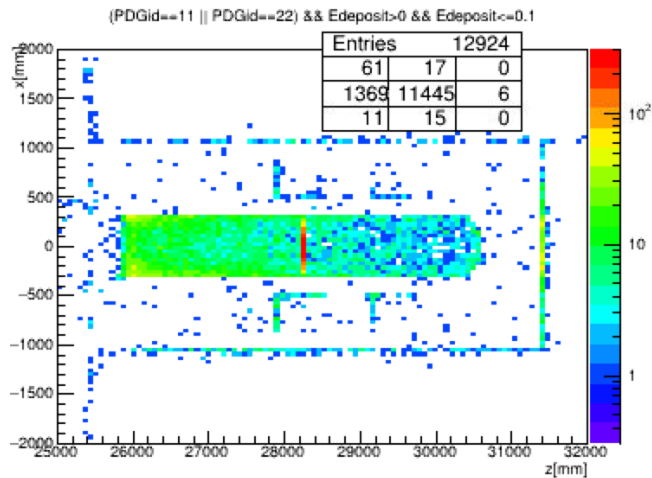
## current setup + 1 ft concrete shield





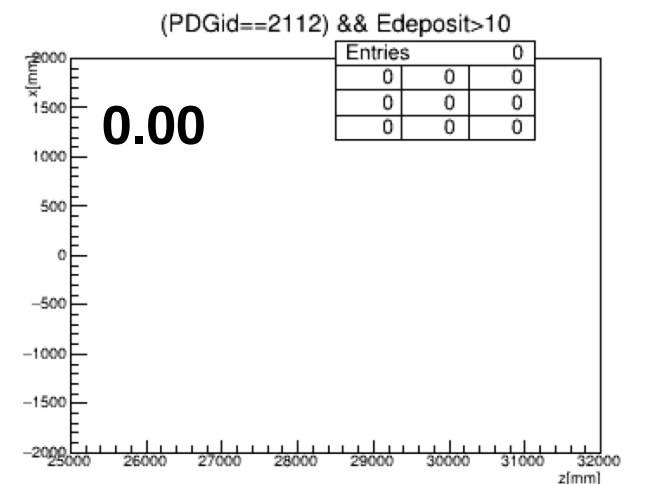
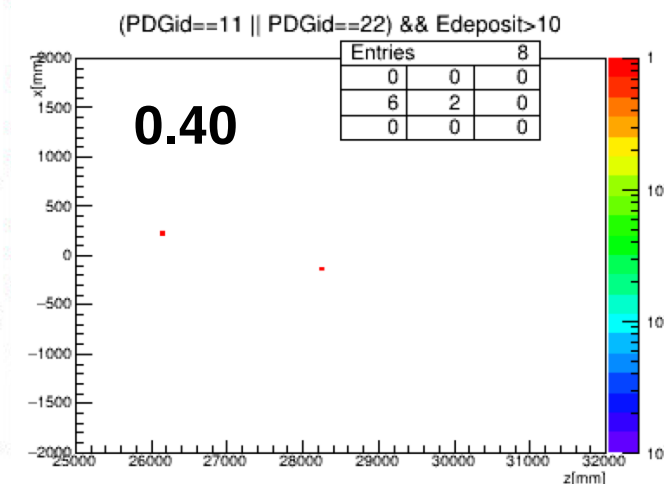
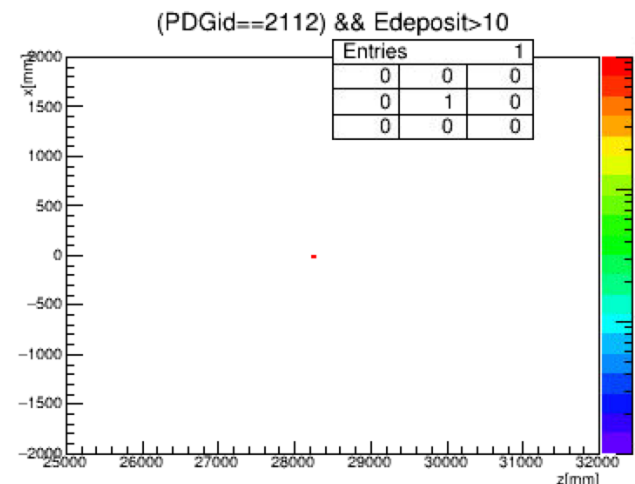
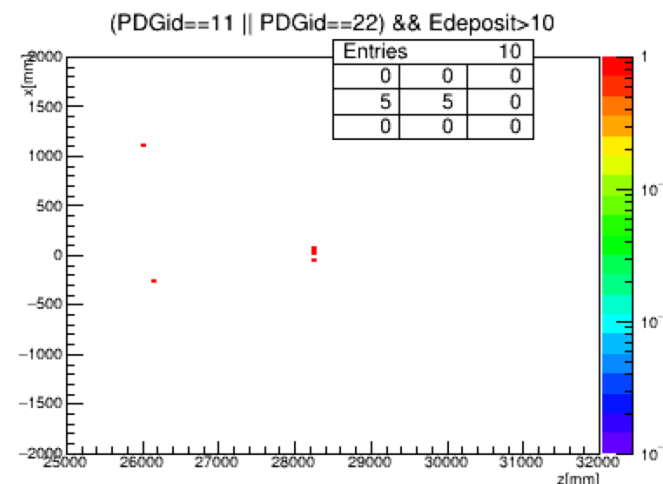
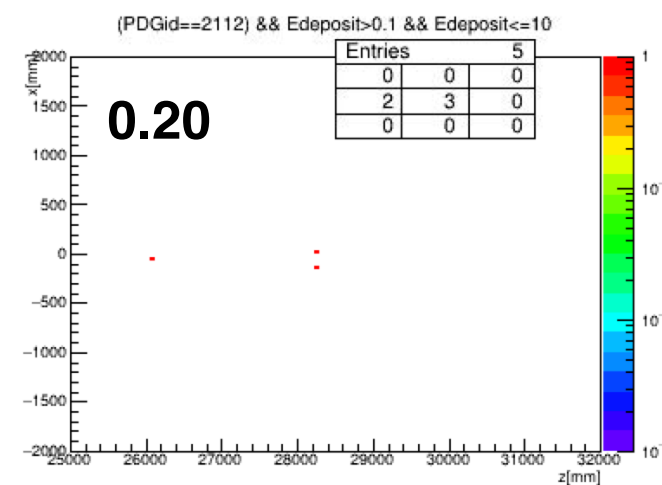
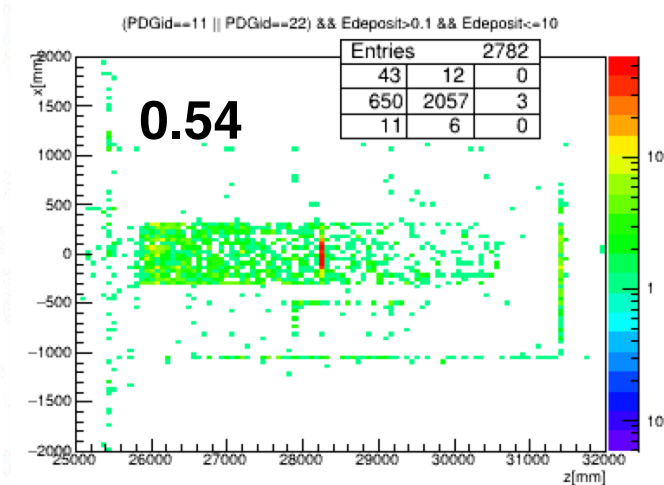
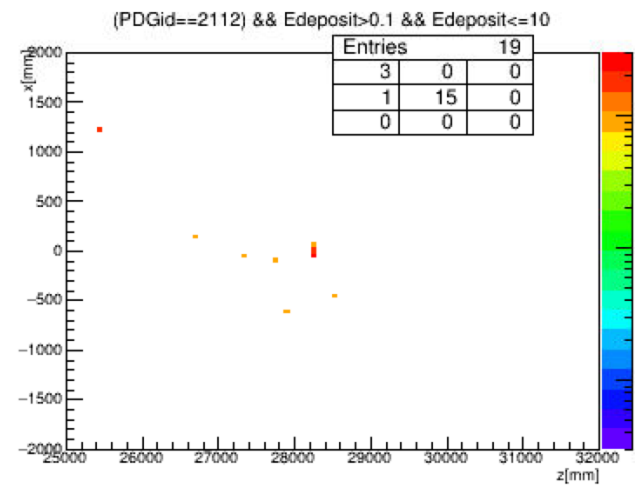
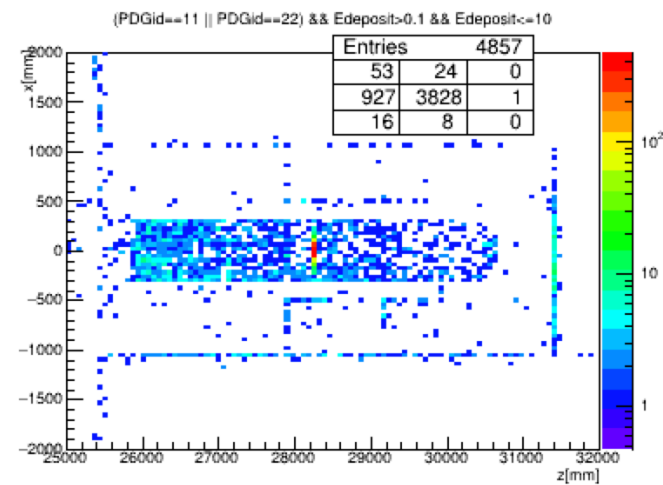
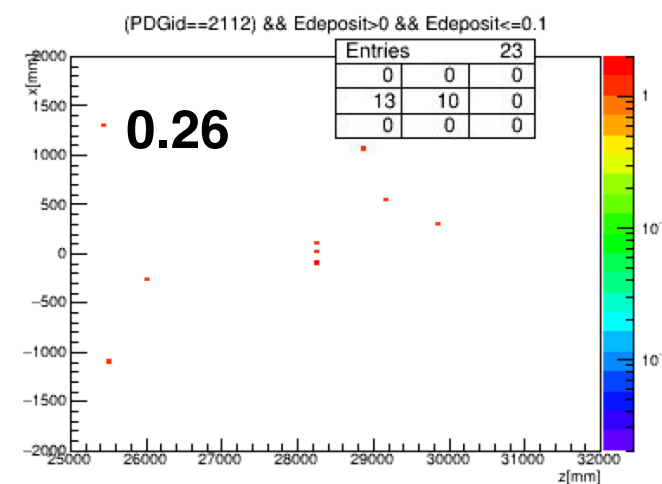
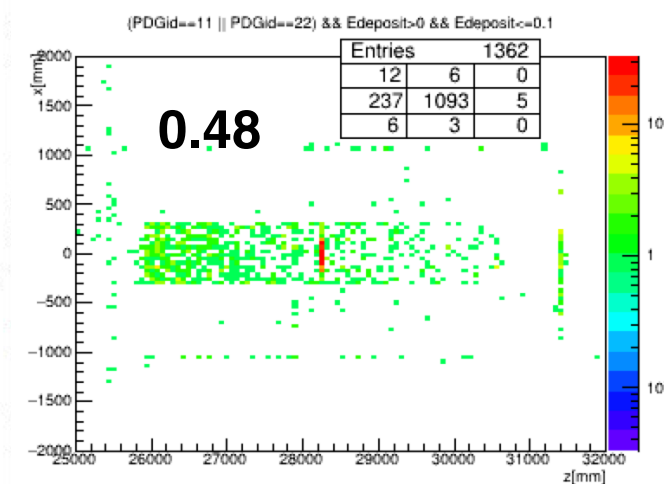
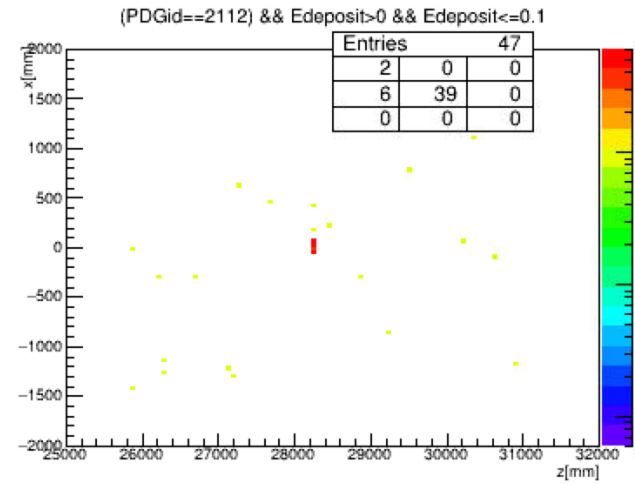
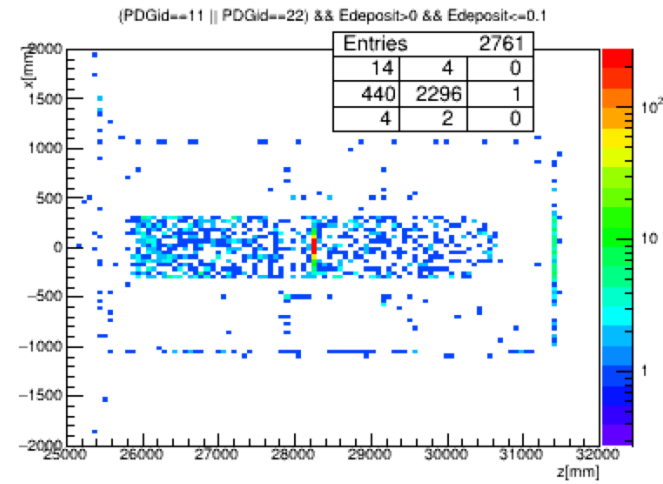
# PREX2 - comparison

## current setup



# CREX - comparison

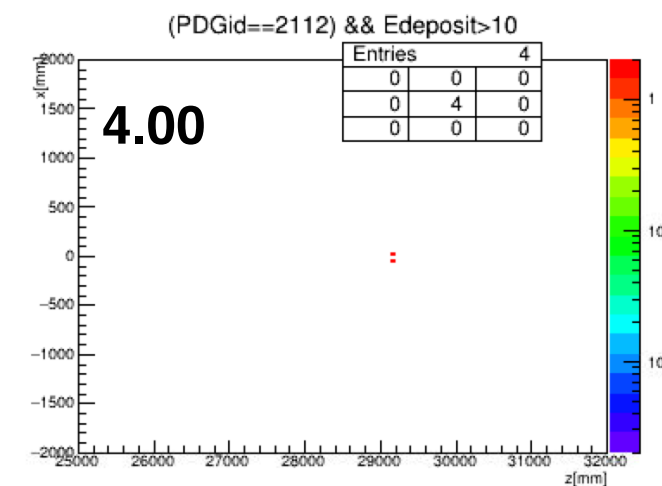
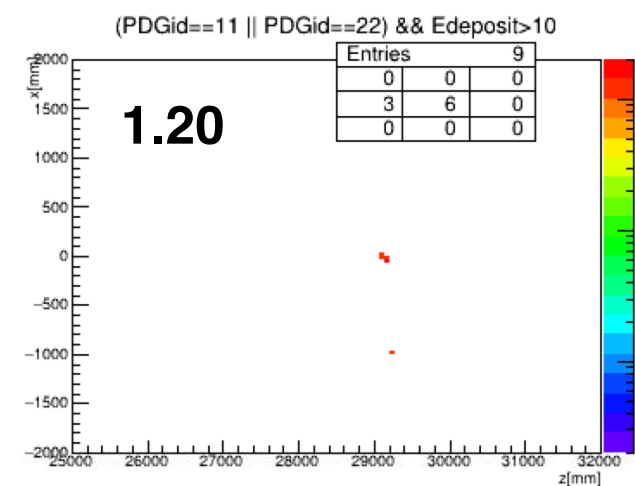
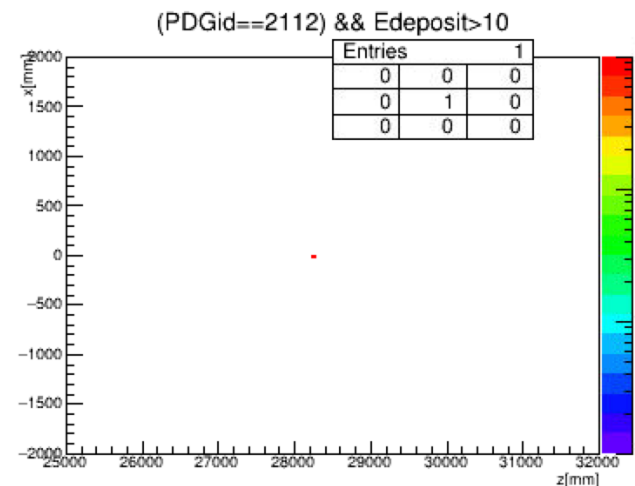
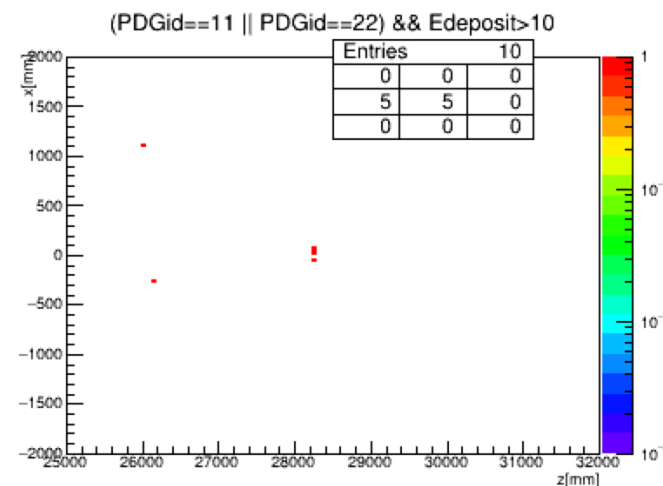
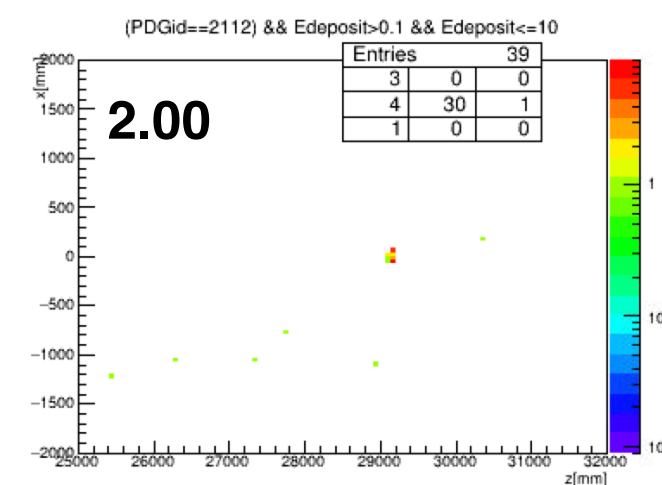
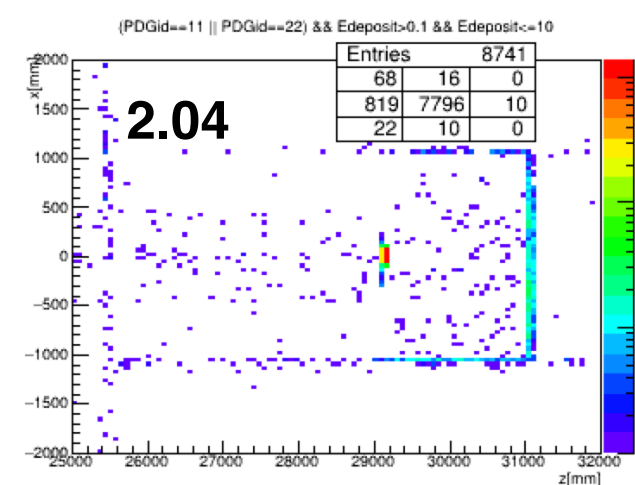
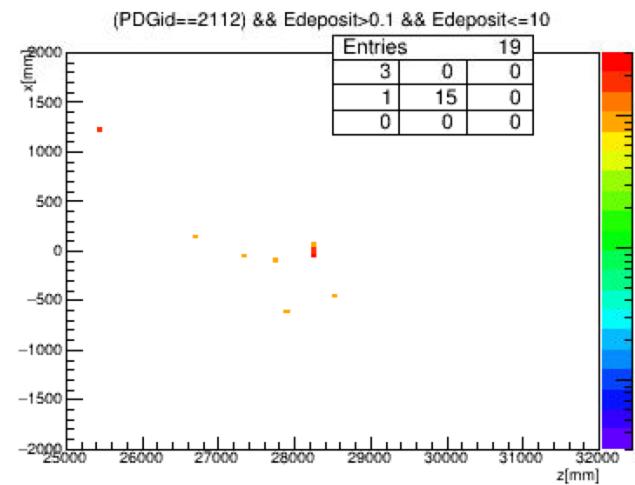
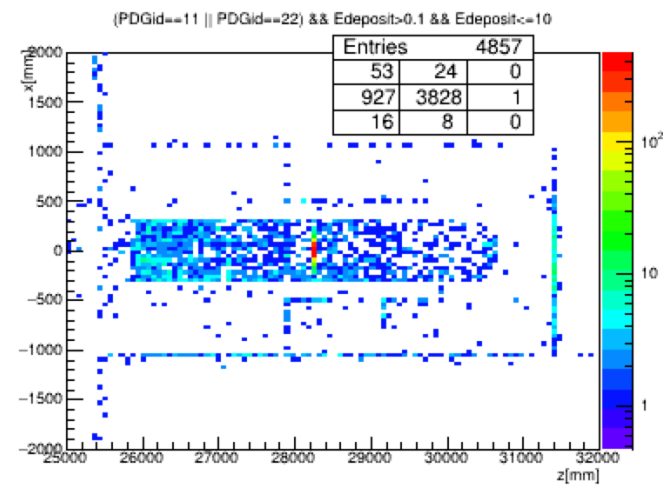
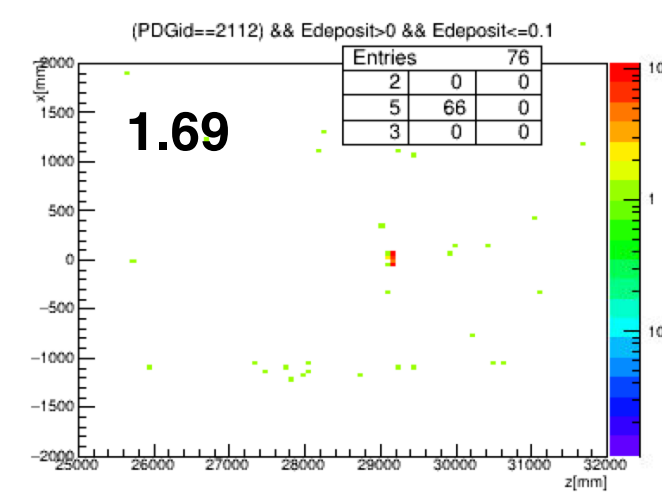
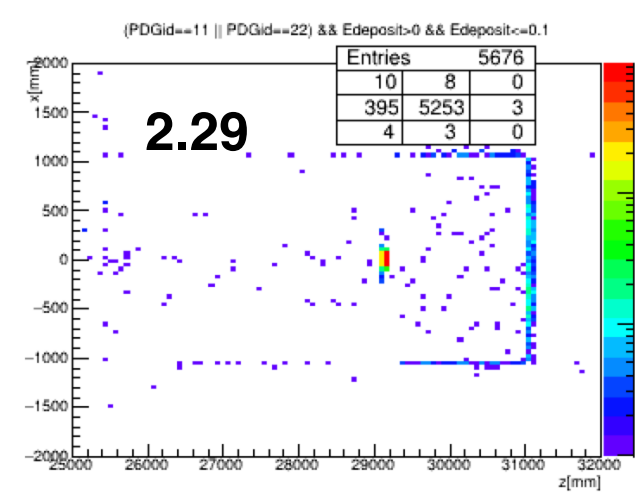
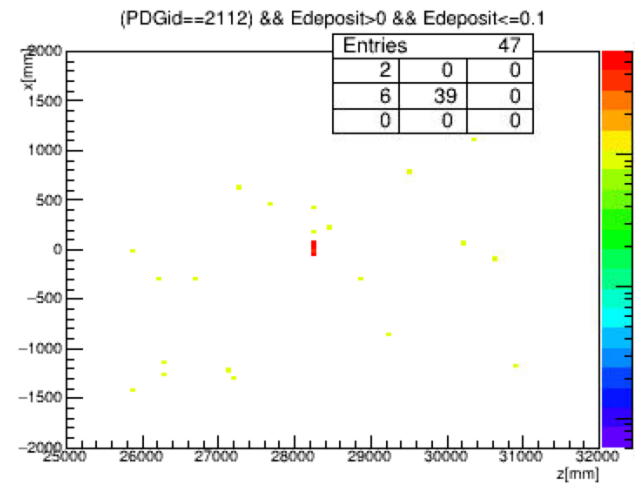
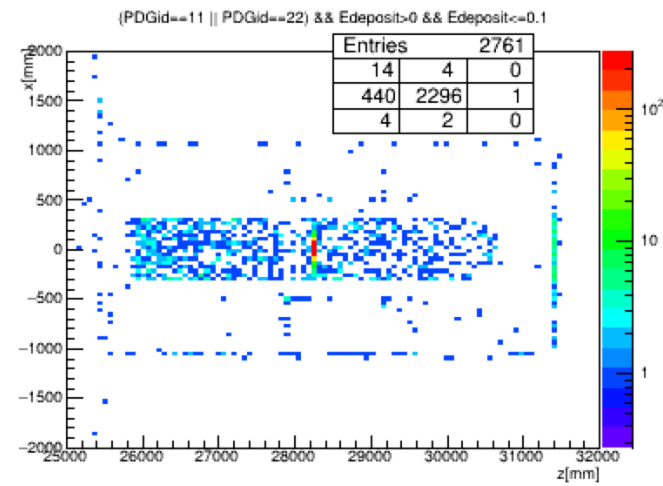
## current setup





# CREX - comparison

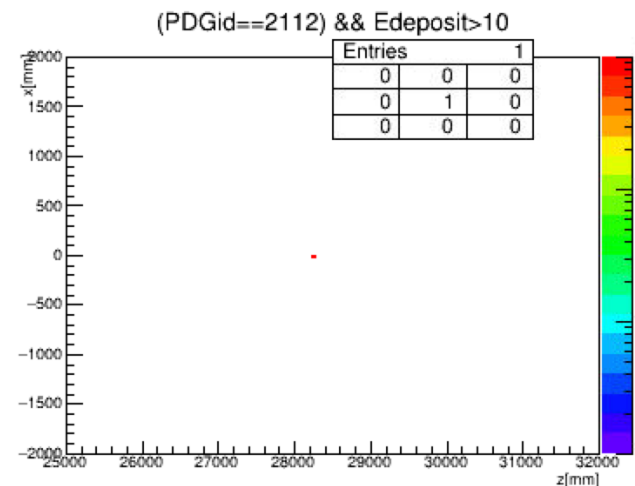
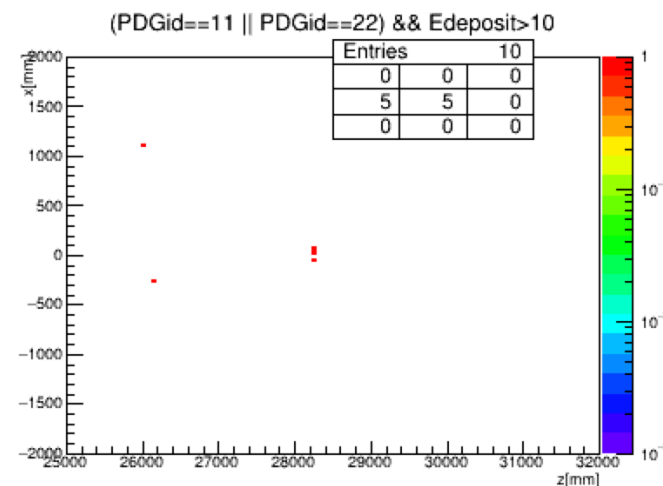
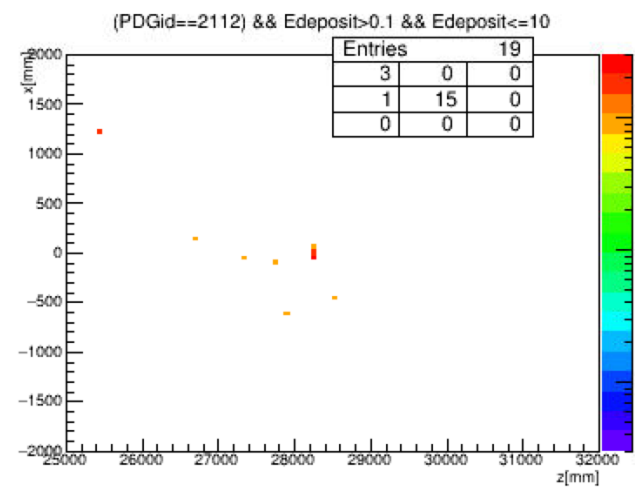
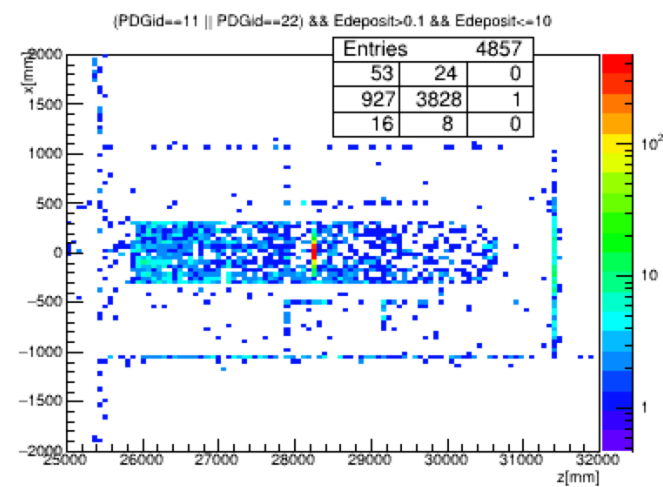
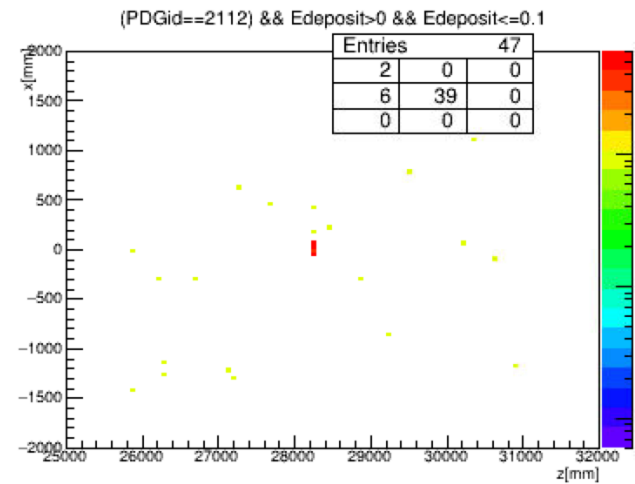
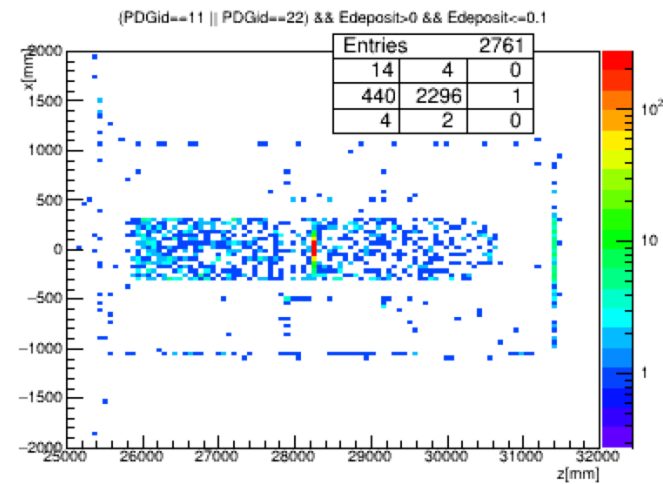
## current setup



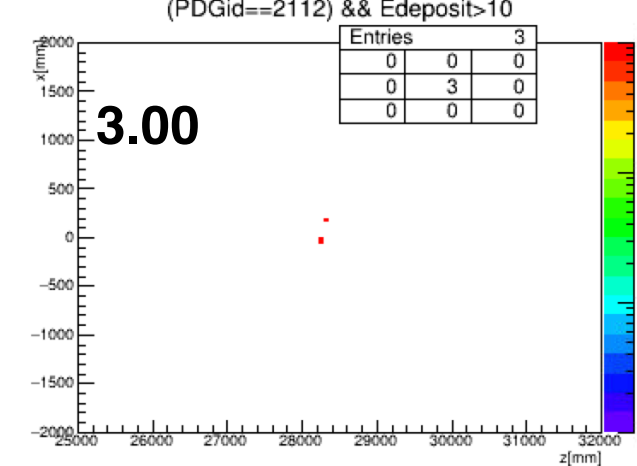
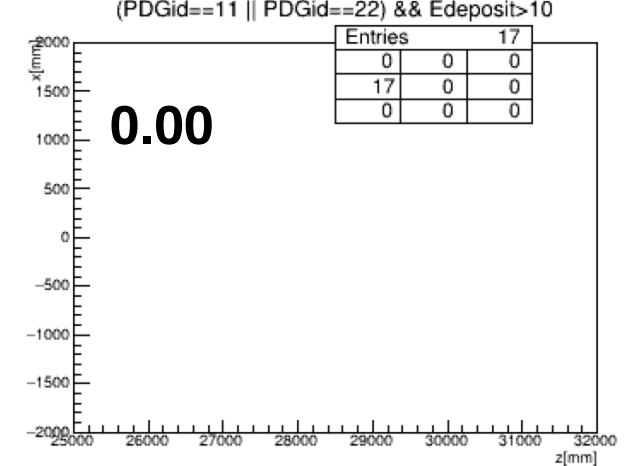
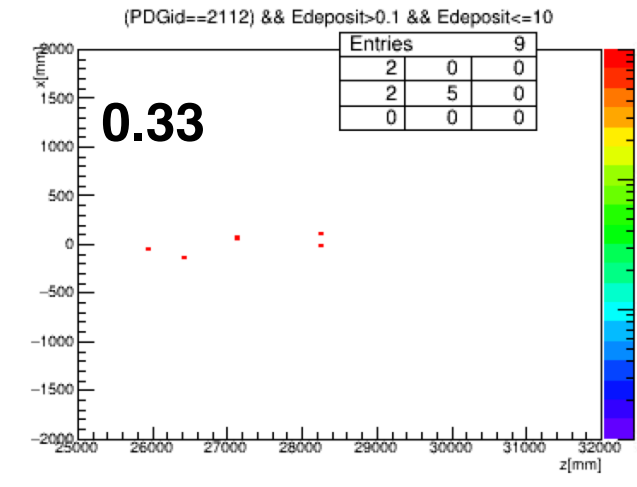
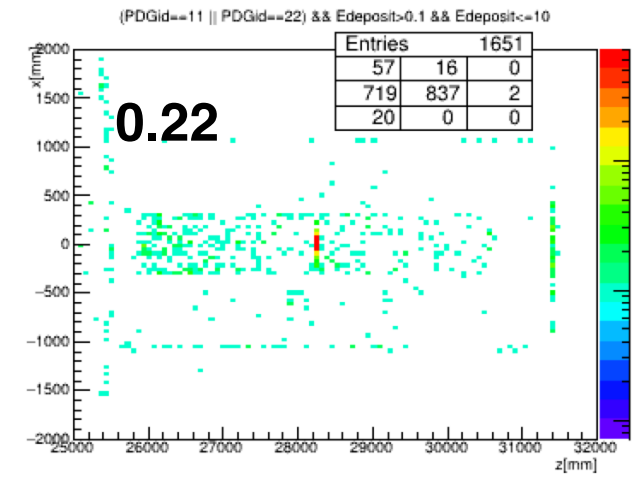
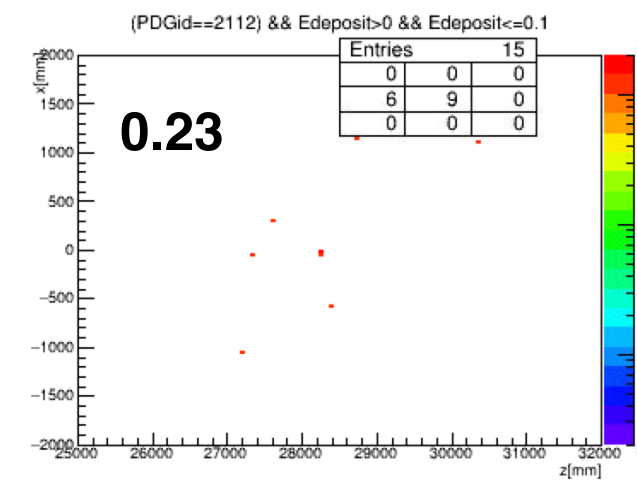
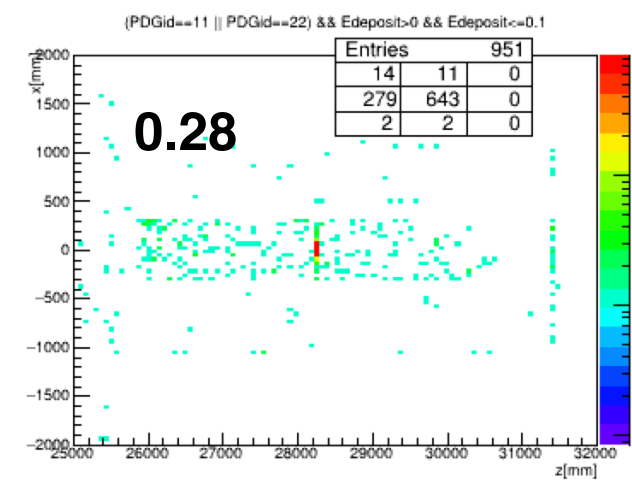
## PREX1 dump setup

# CREX - comparison

## current setup

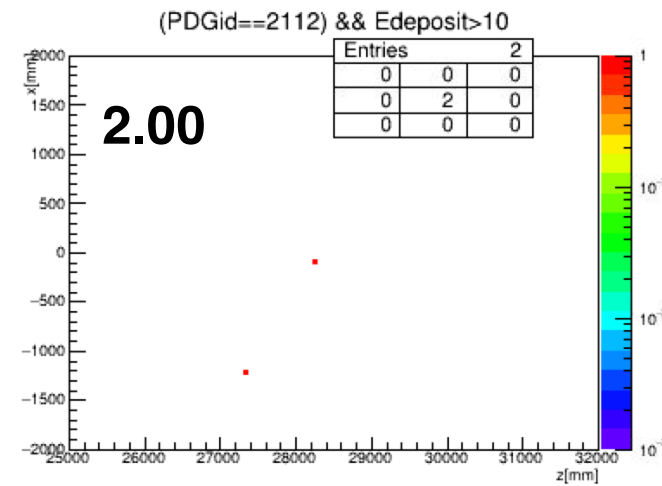
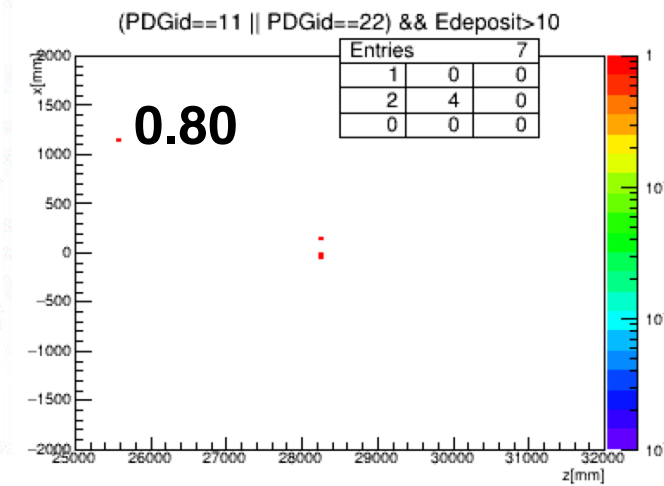
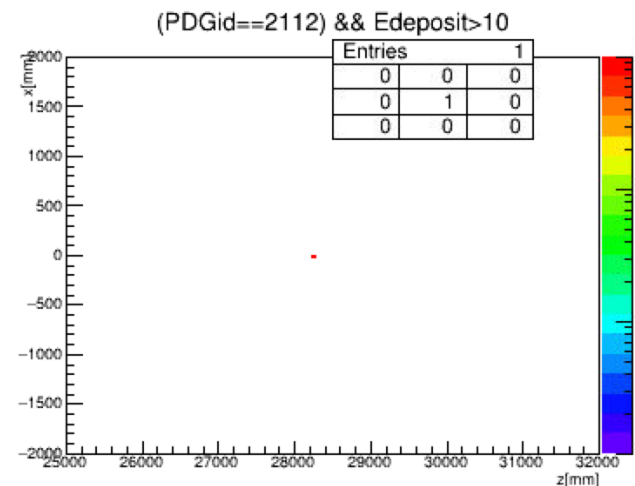
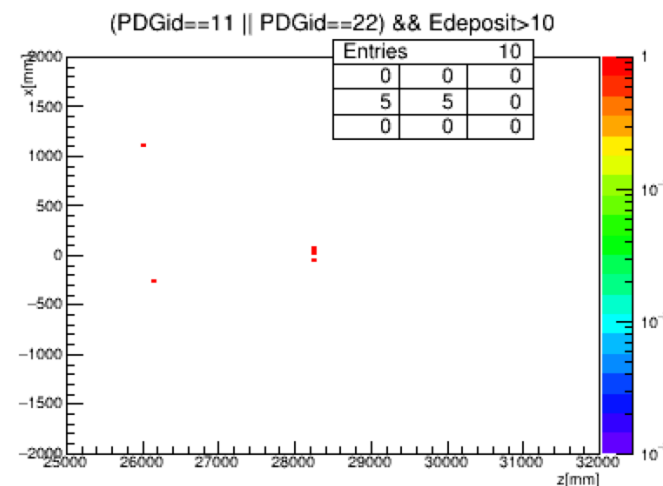
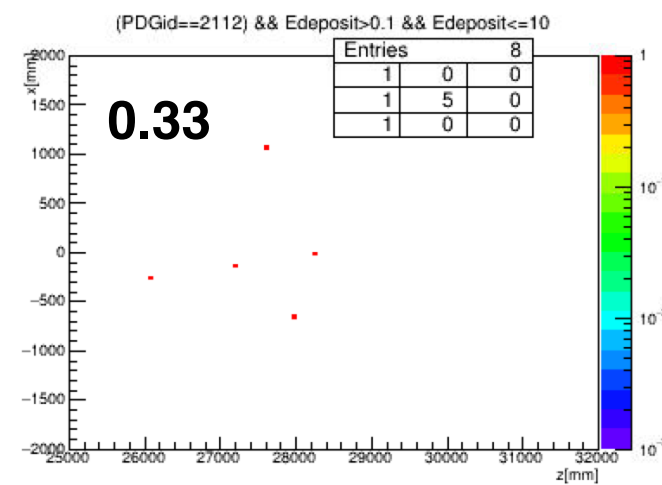
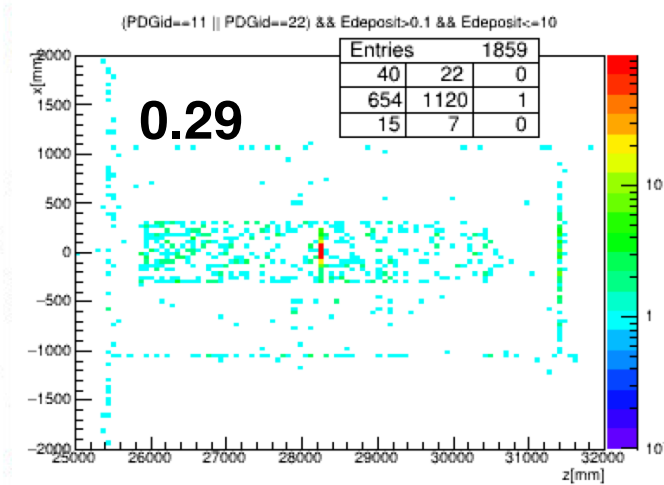
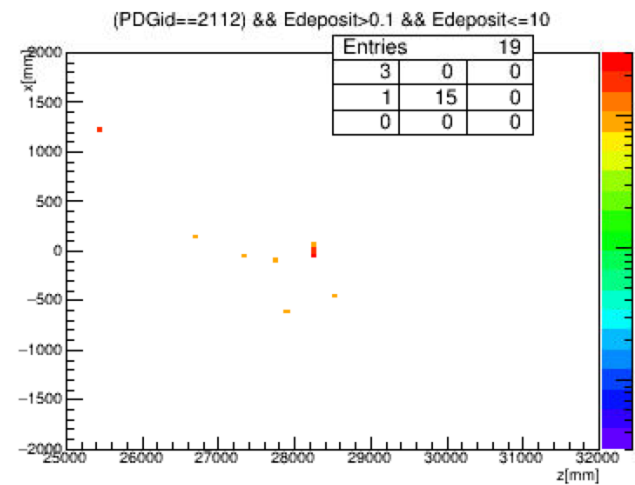
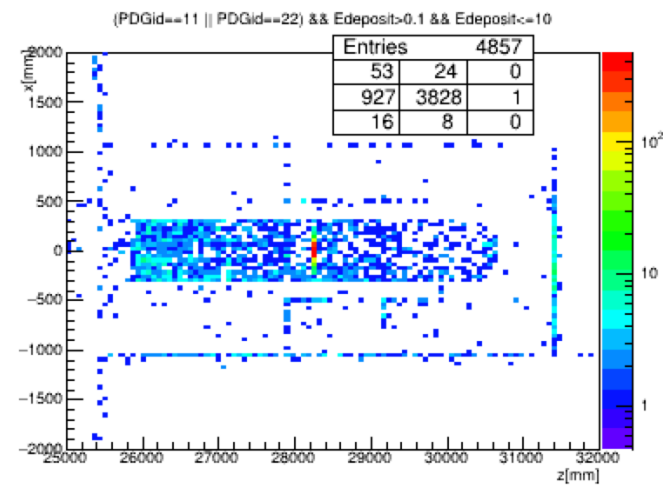
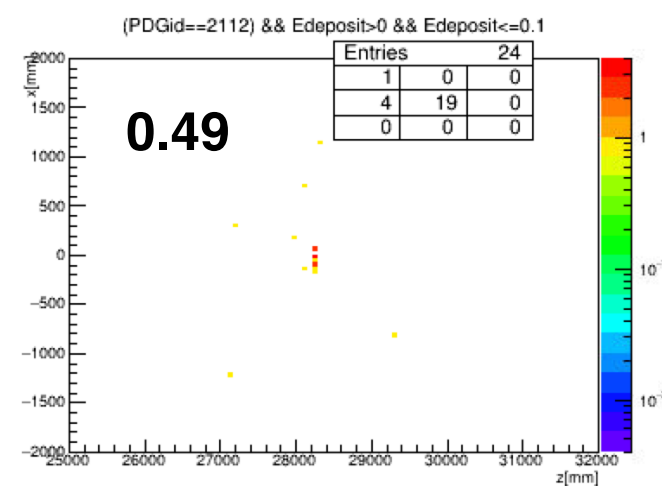
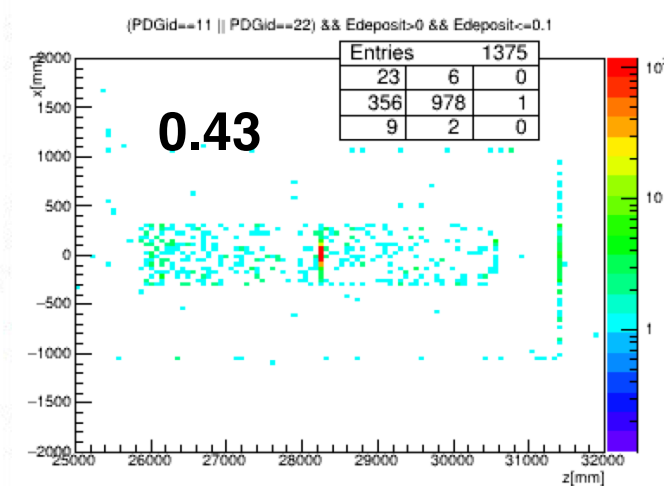
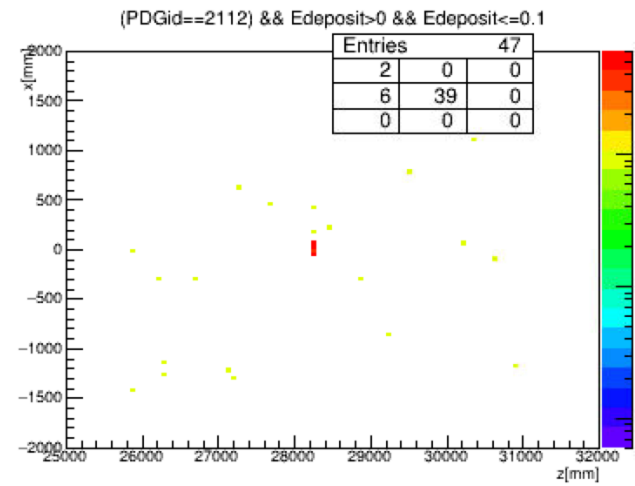
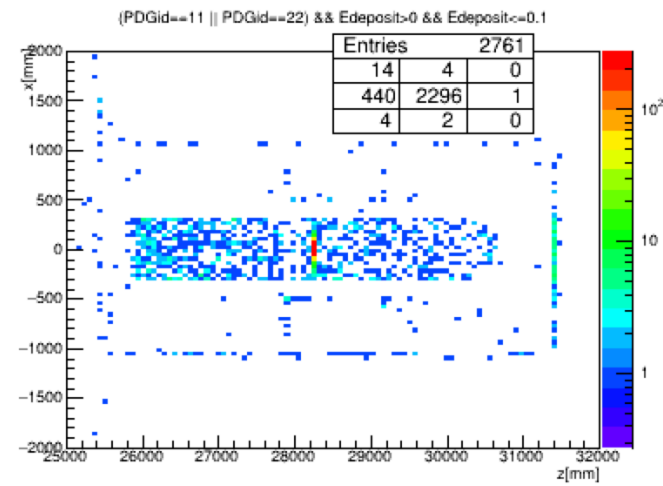


## current setup + 1 ft concrete shield



# CREX - comparison

## current setup



## current setup + 1 ft Poly shield